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SYMPOSIUM: THE CARE OF THE HANDICAPPED SURGICAL PATIENT

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TREATMENT FOLLOWING OPERATIONS FOR ULCER OF THE DUODENUM AND STOMACH[1]

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WITH the marked increase in our knowledge of the physiological effects and complications of various diseases, more active co-operation in treatment between the internist and surgeon is demanded. Surgical mortality has been reduced by the practical application, to the pre-operative preparation of patients, of the fruits of modern scientific research, particularly those of the biochemist and physiologist. This applies especially to operations in the presence of diabetes or cardiovascular disease, disease of the thyroid, kidneys, or prostate, or of the biliary tract associated with jaundice, and, last but not least, gastro-intestinal lesions complicated by retention or obstruction and the resulting characteristic toxæmia. The success achieved in this group by the pooling of our therapeutic resources is the best argument for future co-operation in other fields.

In the treatment of patients who have been operated on for benign lesions of the stomach and duodenum, the resources of the internist have not been sufficiently employed. Balfour has said that the internist should play a large part in making certain the good results that ought to follow proper surgical measures in suitable cases. In this connection the classification of dyspepsia into medical and surgical is unfortunate. There is no class of cases in which the close co-operation of internists and surgeons is more productive of results. In a recent interview, Boas remarked that such an illogical classification only makes the internist cognizant of the failures of the surgeon, and conversely, magnifies for the surgeon the failures of the physician. He felt that in America, in particular, there was evidence that the spirit of co-operation between these two big branches was being increasingly manifested.

The disappointments following gastric operation, the late sequelæ, are interesting to study but sometimes difficult to avoid. The causes of them give the surgeon, clinician, and

[1] Presented at the Clinical Congress of the American College of Surgeons, Philadelphia, October 26–30, 1925.

research worker food for much reflection and speculation. Fortunately such sequelæ are comparatively infrequent when a skillful operation has been performed under proper circumstances. Besides, progress is being made in our knowledge of the causes, prevention, and cure of recurrent lesions.

IMPORTANCE OF CAREFUL EXAMINATION

The chief cause of poor surgical results is the incomplete examination. There is a growing tendency to rely mainly on the results of a roentgenologic examination and to skimp or ignore the case history and gastric analysis. In the hands of the expert radiologist such procedure may reduce erroneous diagnoses and ill-advised treatment to a minimum, but the results of less skillful radiography may be highly unfavorable to both patient and surgeon. The operation based on an erroneous interpretation of the radiologic examination of the stomach is a potential factor for mischief. This error might be avoided by a careful marshalling of all the facts.

The high incidence of associated lesions of the accessory digestive tract in cases of peptic ulcer makes routine inquiry for evidence of disease in the appendix, gall bladder, and pancreas essential, for an incomplete operation is not an infrequent cause of incomplete cure. The results of gastric analysis are important from both a diagnostic and a surgical standpoint. Exclusive of gastric retention, one of the most important disclosures of the test-meal is achlorhydria or achylia. If present on a second examination by a fractional meal this secretory abnormality may connote various possibilities. The syndrome of ulcer may be simulated by so-called achylia gastrica, and I know of several such cases in which gastro-enterostomy was performed by competent surgeons with no relief, or even with the addition of more disturbing symptoms. Anacidity in the presence of roentgenologic deformity characteristic of ulcer of the stomach or duodenum may postulate: (1) an inactive, healed, malignant, or syphilitic lesion; (2) the association of one or various diseases ranging from chronic cholecystic disease to pernicious anæmia; or (3) an asthenic, neurotic state coupled with a hypotonic or dilated stomach.

While surgical interference is imperative when the possibility of malignancy of a gastric ulcer arises, when a duodenal ulcer is of the hæmorrhagic or perforative type, or when there is evidence of associated disease of the gall bladder or appendix, the secretory status would call for some procedure other than gastro-enterostomy. Excision, with or without pyloroplasty, is to be preferred. It has been found necessary on several occasions to administer hydrochloric acid after gastro-enterostomy performed for duodenal ulcer, on account of persistent primary subacidity. The mimicry of ulcer by other conditions, functional and organic, the coincidence of other diseases, and the fact that intrinsic gastric lesions constitute only a small percentage of the causes of dyspepsia, make a complete clinical study imperative.

CASES SUITABLE FOR OPERATION

The surgical prognosis for the neurotic, asthenic, mentally or constitutionally inferior, ulcer-bearing patient is often poor, especially if the symptoms of ulcer are not characteristic or are not in the foreground. My experience with the medical management of these patients has made me more sympathetic with the surgeon in his dealing with these post-operative complaints. Conservatism or a guarded prognosis in the event of an operation should be the rule. The young patient with a short, uncomplicated history is usually not a good subject for operation and, if his co-operation can be secured, a course of careful medical treatment should first be tried. The small gastric ulcer of short duration, without retention, lends itself well to a course of medical treatment, although the possibility of malignancy in elderly patients must always be borne in mind. While it may be a commentary on our shortcomings in diagnosis and treatment, it is a fact that most of our patients have a chronic indurated lesion, with symptoms extending over an average period of 10 years, and that complications have occurred singly or in combination in more than one-third of them. In this large group operation is the *sine qua non* of treatment, and medical measures should be employed only as complementary to surgical procedures, or in

those cases in which there are serious contra-indications to operation. Ryle asserts that the most important contra-indications to gastro-jejunostomy are a short history, well marked hypertonus, a high, abrupt curve of acidity, and rapid emptying; and that the most reasonable indications for operation, apart from obvious stenosis, are a long history, subnormal tonus, a slowly climbing curve, and slow emptying. I have been repeatedly impressed by how easily gastric acidity is brought under control, or complete neutralization accomplished, in some patients undergoing treatment in hospitals, and how favorably they respond to gastro-enterostomy, and how in others the opposite results may obtain, at least under treatment. This varying result, with an increasing knowledge of variations in physiologic types, gives great promise of informing the surgeon beforehand what type of surgical procedure is indicated and what the ultimate results will be.

POSTOPERATIVE CARE

Clinical course. The necessity for postoperative supervision in well-selected cases is not great, although in many instances a regulation of the mode of living and eating, correction of certain habits, or the eradication of infective foci is indicated. When symptoms do recur, the nature and extent of postoperative care is usually dependent on their nature and severity. Of major importance are epigastric pain or distress, nausea, epigastric fullness, regurgitation and vomiting, and hæmorrhage from whatever cause or source. Many of these symptoms, singly or in combination, may be engendered either by functional disturbances or organic lesions. In the former case, they invariably resolve under medical supervision and treatment. The factors to be kept in mind are: failure of the primary ulcer to heal or its reactivation, irritation of the tissues about the stoma, motor disturbances from mechanical causes, and recurrent lesions, which may also provoke motor impairment. The diagnostic factors furnished by the anamnesis, clinical examination, gastric analysis, and radiologic examination are usually sufficient to determine the source of the complaint. In a recent study of 150 cases with secondary or anastomotic ulcers, it was shown that the symptoms resulting therefrom were usually similar to those provoked by the original lesion and had a tendency to assume identical histopathologic characteristics (13). It was also observed that the ulcer which gave rise to mild or vague symptoms, with normal or subacid gastric contents, and which had a tendency to bleed, invariably had its origin in focal infection. About half of these were not seen fluoroscopically and had a definite tendency to recur or continue to bleed after operation if the infective foci had not originally been eliminated.

Dietetic principles. A proper dietetic regimen is essential to cure or relief in all types of intrinsic gastric disturbances. It appears to be a matter of common sense that a stomach handicapped by disease and the temporary trauma and disability imposed by operation, should not be subjected to gastronomic insult. There is a disagreement of opinion as to the degree to which postoperative management should be carried out. Balfour believes that susceptible patients might develop functional digestive disturbances in exchange for the organic complaint when the postoperative treatment is too rigidly exacting. On the other hand one might rightfully argue that no supervision would be productive of greater mischief to the greater number. The obvious thing to do is to individualize treatment after a consideration of all the facts. There is no reliable evidence that adequate postoperative treatment has prevented recurrence or the formation of a gastrojejunal ulcer, although it is reasonable to assume that it could. It may prevent and does relieve the more common disturbances of a functional nature. It is surprising how well patients have done with little or no restriction in diet or regulation of family habits of eating. In my opinion medical supervision for from 4 to 6 weeks at least after operation is important until complete healing has occurred, and in the group in which postoperative sequelæ might reasonably be expected.

Flint has shown in animals that the new formed anastomosis is the site of a healing ulcerated surface for about 2 weeks. Clinical experience repeatedly demonstrates that ul-

ceration in the suture line, regardless of the type of operation, or at the gastrojejunal orifice, may appear shortly after operation. An intact gastric mucous membrane can tolerate much abuse, but in the presence of ulceration or during the healing process a proper regimen may determine the ultimate success or failure of the surgical procedure. During the outpatient convalescent period it is not uncommon for uninstructed patients to eat large indigestible meals and suffer gastric retention. If this is promptly recognized and treated no harm is done, but if not, much discomfort and considerable delay in recovery may ensue.

So far as is now known, the second group which requires supervision consists of the young, careless patients with hyperacid secretion but without gastric obstruction, and the nervous, worried, hyperirritable, hard-working male adults. A modified, simple, commonsense regimen for all patients has two other advantages: it disarms criticism directed rightly or wrongly against surgeons for making short shrift of non-surgical therapeutic methods, and the ailing patient who has wilfully ignored his instructions or committed gross indiscretions will not lay all the blame on the surgeon and his art. In the clinic a booklet containing instructions of a general nature, the proper selection and preparation of food and suitable recipes, has been found useful and time-saving. In principle, the patient is advised to avoid highly seasoned, coarse and fried foods, condiments, tobacco, alcoholic stimulants, and strong tea and coffee. To this may be added the present-day slogan so applicable to the American public, "Eat half as much and twice as long."

INDICATION FOR THE USE OF ALKALIS

The importance of persistent or recurring hyperacidity in cases of postoperative morbidity is just beginning to be appreciated. Clinical hyperacidity or hypersecretion, or both, are present in most cases of ulcer, especially during the period of active symptoms. Carlson has demonstrated its unfavorable influence on the function of the pylorus and duodenum in provoking undue spasm and contraction and thereby aggravating the symptoms characteristic of ulcer in its presence. Sippy has called attention to the association of delayed emptying and excessive continued secretion with recurrence after gastro-enterostomy. Internists and surgeons alike have stressed the highly probable causal relation of hyperacidity to recurrent ulcer. Recent contributions by Hurst, Bolton and Goodhart, Sherren, and Walton have emphasized this relation. Experimental proof is not lacking. By diverting the alkaline secretions which neutralize the gastric juice, Mann and Williamson were able to produce typical subacute or chronic peptic ulcer in a high percentage of animals, comparable pathologically to that found in man. In more recent experiments Mann has shown that if the ulcer is protected from contact with the gastric juice, healing is complete and reasonably rapid. By the judicious use of alkalis, the pain and acidity of peptic ulcer can be controlled, especially when a proper diet and rest are also employed. There is clinical and experimental evidence that alkalis exert a healing influence. Dragstedt and Vaughn produced experimental ulcers in dogs, many of which failed to heal normally because of the persistent irritant effect of non-absorbable sutures. When alkalis were administered in amounts sufficient to neutralize gastric secretion the lesion promptly healed. Besides their neutralizing effect, alkalis decrease gastric tonus, inhibit regional spasm in the presence of ulcer, and partly immobilize the pylorus. The kymographic studies of Joseph and Hardt have shown further the inhibitory effect of alkalis and frequent feeding on gastric tonus, peristalsis, and acidity. Thus we have a sound clinical and physiologic basis for the postoperative use of alkalis under definite conditions. For routine purposes a combination of calcined magnesia and bismuth subcarbonate, in doses of 10 and 15 grains respectively, from 1 to 2 hours after meals with a quarter of a glass of water, is recommended. A glass of rich milk may be taken an hour thereafter or may be combined with the powder. The dose may be increased or reduced, and sodium bicarbonate and calcium carbonate substituted, or alternated according to indications. A certain amount of caution is necessary as alkalis in unnecessarily large doses may cause gastric irritation or a

tendency to alkalosis, as emphasized by Hardt and Rivers.

UNFAVORABLE EFFECT OF TOBACCO

The excessive use of tobacco is deleterious to the health of the patient with peptic ulcer. In those susceptible to the influence of nicotine, moderate amounts may be harmful. The patient who craves tobacco invariably consumes excessive amounts and the habit should be discouraged. Langley showed that nicotine paralyzes the synapses of the sympathetic nervous system, so that dyspeptic symptoms in habitual smokers are logical, owing to unopposed vagal action. Wagner concluded from a recent investigation that all the subjective and roentgenologic signs of duodenal ulcer can be produced by the excessive use of tobacco. During the last decade the typical syndrome of peptic ulcer has been occasionally observed in young adults given to excessive cigarette smoking, and their discomforts have disappeared largely through the discontinuance of the habit. Moynihan is convinced that smoking is a harmful habit under the circumstances, that an "attack" of duodenal ulcer often follows an orgy of tobacco, and that abstinence may check such an attack. German clinicians are loath, or refuse, to accept for treatment the patient with peptic ulcer whose fingers are tobacco-stained. I have frequently noticed the peculiar psychologic fact that patients of physicians who are inveterate smokers are not as a rule warned to discontinue or restrict the use of tobacco.

The definitely better end-results that are obtained in either the surgical or non-surgical treatment of ulcer in women should furnish a therapeutic hint and justification for postoperative precautions. While factors of an anatomic, physiologic, and occupational nature may play a part, I feel that such greater success is due more to their whole-hearted and continued co-operation regarding matters of diet and mode of eating, and to the fact that generally speaking they are not handicapped by the excessive use of tobacco and alcohol.

FACTORS PROVOKING HÆMORRHAGE

Exact determination of the cause and source of hæmorrhage from the upper digestive tract is often extremely difficult. The effect of extragastric conditions is not generally appreciated. While it is important to exclude a lesion of the stomach or duodenum in every instance of hæmorrhage, the fact remains that chronic intrinsic lesions are not found in the majority of all patients with hæmatemesis or melæna. It is true that when the hæmorrhage is the result of a bleeding ulcer, its complete removal insures against further hæmorrhage unless extrinsic conditions are also present which may give rise to hæmorrhage, such as cirrhosis of the liver, chronic cholecystic disease, with or without hepatitis, hæmophilia, and splenic disease. I have recently observed that unusual exertion or an alcoholic debauch by patients with ulcer or conditions extrinsic to the stomach which may provoke gastro-enteric hæmorrhage, is likely to be followed by hæmorrhage. I could cite a number of interesting case records to prove this point. Patients for whom gastroenterostomy has been successfully performed for bleeding ulcer may, after years of complete health, have another hæmorrhage, the result of such unaccustomed exertion as cranking a car in cold weather, felling a large tree, driving forty or fifty golf balls during practice, or strenuous hunting; an alcoholic debauch may have the same effect. Instances are also on record of patients who have had symptoms of peptic ulcer for a long time but without hæmorrhage, experiencing a hæmorrhage after the injudicious use of alcohol, especially the moonshine brand. The last instance of severe hæmorrhage and anæmia following exertion that I saw was in a dyspeptic patient who at operation had chronic cholecystitis and hepatitis without a demonstrable lesion in the stomach or duodenum.

SUMMARY

The co-operation of internist and surgeon in the pre-operative preparation of patients has strikingly reduced the surgical mortality in various types of diseases. A similar pooling of therapeutic resources after operation should reduce surgical morbidity to a minimum. Pre-operative factors enhancing surgical end-results in cases of benign gastroduodenal lesions are their proper selection both from a general and a special standpoint, and the com-

plete examination of the patient. It is predicted that our increasing knowledge concerning physiologic gastric types and their variations and mode of response to treatment, will furnish criteria for the proper selection of the operation. The patient who has been well chosen and skillfully operated on invariably does well without any exact postoperative regimen. Recurrent ulcers, while infrequent with experienced surgeons, as a rule give rise to symptoms similar to those provoked by the original lesion, and tend to assume identical histopathologic characteristics. The use of proper diet, alkalis, frequent feedings, and so forth, immediately after operation for about 6 weeks at least, and for a longer period in certain types of cases, rests on sound experimental and clinical ground. The better end-results in the medical or surgical treatment of ulcer in women than in men are largely due to their superior personal and eating habits and better co-operation in general. The habitual or excessive use of tobacco is harmful to the patient with peptic ulcer. In such patients gastro-enteric hæmorrhage may be provoked by the abuse of alcoholic drinks or unusual exertion.

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FUNDAMENTAL PRINCIPLES IN SURGERY OF THE STOMACH AND DUODENUM; REPORT OF FOUR HUNDRED CASES[1]

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SINCE January, 1924, a certain routine has been followed at the Mayo Clinic in the management of patients with serious or complicated lesions of the stomach or duodenum, particularly carcinoma of the stomach, recurring peptic ulcer, and pyloric obstruction. More intensive study and preoperative preparation of such patients by the gastro-enterological staff has added very definitely to the efficiency of their treatment, and has made more exact and safer operations possible. My own experience with observing such patients in the hospital pre-operatively, in conjunction with the gastro-enterological staff, has been so gratifying that I wish to report a series of 400 consecutive operations for lesions of the stomach and duodenum, which were done in a period of 15 months following the establishment of this practice.

TABLE I.—CLASSIFICATION

Diagnosis	Cases	Hospital mortality
Gastric carcinoma	113	1
Gastric ulcers		
Chronic and subacute	49	1*
Acute perforating	2	
Recurring	7	
Duodenal ulcers		
Chronic and subacute	146	1
Recurring	15	
Combined gastric and duodenal ulcers	13	
Gastrojejunal ulcers	22	1
Carcinoma of duodenum	1	
Sarcoma of stomach	1	
Syphilis of stomach	2	
Benign tumors of stomach	2	
Malfunctioning or unnecessary anastomosis	10	
Miscellaneous (pylorospasm, pyloric obstructions, and so forth)	17	
Total	400	4

*Jejunostomy only.

OPERATIVE MORTALITY

In this series of 400 cases there were 4 operative deaths: 1 from bronchopneumonia 10 days after a difficult partial gastrectomy for advanced carcinoma involving the pancreas, the resection having been ill-advisedly undertaken as a palliative measure to relieve obstruction; 1 from acute pancreatitis following partial gastrectomy for multiple gastrojejunal ulcers associated with subacute pancreatitis; 1 from the extension of a retroperitoneal infection into the general peritoneal cavity 10 days after excision of a large bleeding duodenal ulcer of the posterior wall and followed by gastro-enterostomy in a patient with marked secondary anæmia; and 1 following jejunostomy for a large subacute perforating ulcer at the cardia in a patient whose condition was so bad that even this operation was questionably advisable (Table 1).

I have recently emphasized the importance and value of co-operation between internist and surgeon in the care of such cases,[2] particularly those in which complications either increase the difficulty of interpretation or the risk of operation, or both. Care of patients in the hospital before operation is the keynote of the successful management of these cases, the advantages of this preliminary treatment being of particular value for patients with obscure or complicated disorders; for patients with recent gastro-intestinal hæmorrhages; for patients who have had previous (often multiple) operations on the stomach and duodenum; for patients with ulcers showing recent exacerbations and extension of inflammatory products; for patients with gastric carcinoma; for patients with gastric obstruction and retention; and, in general, for patients in poor physical condition. The careful pre-operative preparation of such patients has been of extraordinary aid in determining the indications for surgical procedure, the optimal time for it, and in making it possible to perform safely, difficult technical operations when the surgical risk was great. Equally careful supervision must be maintained during convalescence.

Anæsthesia. The danger from pulmonary complications following upper abdominal

[2] Balfour, D. C. Value of co-operation between internist and surgeon in the management of complicated gastric conditions, with some remarks on partial gastrectomy. J. Am. M. Ass., 1925, lxxxiv, 876-879.

[1] Presented at the Clinical Congress of the American College of Surgeons, Philadelphia, October 26-30, 1925.

operations is well known, but recent developments in anæsthetics have apparently aided in definitely diminishing the incidence of such complications. In this series of cases, ethylene has been the general anæsthetic, combined, when necessary, with novocain to produce block anæsthesia, or sufficient ether to give satisfactory relaxation. Morphine 1/6 grain and atropine 1/150 grain have been given as a routine half an hour before operation. The almost total absence of pulmonary morbidity and the low mortality in 400 operations on the stomach and duodenum, 113 of which were for carcinoma, more than suggest the advantages of ethylene in these cases at least. The two disadvantages of ethylene are its inflammability and the difficulty of efficient administration. The former is not a menace if reasonable care is exercised, and the latter can be overcome by experience. Lundy has recently introduced into the Mayo Clinic, a combination of carbon dioxide with ethylene, which is more effective than ethylene alone.

SURGICAL AIDS

There are certain points with regard to surgery of the stomach and duodenum which are always worthy of repetition. The first is adequate exposure, in which long incisions, usually in the left rectus, and self-retaining retractors and packs, are valuable aids. The second is adequate mobilization. This applies particularly to large gastric ulcers adherent posteriorly. It is frequently possible, by methodical mobilization of the stomach, to carry out satisfactorily, partial gastrectomy or excision, when the ulcer is situated so high that on first impression it appears to be irremovable. The third point is absolute hæmostasis. This can always be secured if scrupulous care is taken in the ligation of individual vessels and in the placing of sutures. The fourth point is the importance of avoiding incomplete operations, since a primary radical operation can often be performed with no more risk than an incomplete one, or one intended as the first of a two-stage procedure. Another very useful adjunct is the suction pump. I have made it a routine to empty the stomach completely before finishing the operation, and often to empty and collapse the distended stomach with the pump before beginning the mobilization, as suggested by Devine. Finally there must be a proper appreciation of the mechanics of whatever operation is being performed; that is, the restoration of gastro-intestinal continuity in such a way that adequate drainage is secured. Trauma should be kept at a minimum.

POSTOPERATIVE CARE

In the postoperative care, rest of the stomach and upper intestinal tract are of first importance. The more extensive the operation, the longer should this rest be maintained. For example, in cases of complicated resection, fluids by mouth are withheld for as long as 4 days, the proper fluid balance being maintained by proctoclysis, hypodermoclysis or intravenous administration. When stimulation is needed, coffee given by proctoclysis is satisfactory. The unrestricted employment of the stomach tube is of great importance. Retention of secretions is not permitted; whenever uncertainty exists, the tube should be passed. A quick pulse and anxious facies may be entirely due to retention. The prompt recognition of complications and their prompt control are vital. The early detection, by studies of the chemistry of the blood, of the toxæmia of high gastro-intestinal obstruction and its control by the intravenous administration of physiologic sodium chloride and glucose solutions are now well appreciated.

OPERATIONS

The *duodenal ulcers* in the series have usually been of the type suitable for gastro-enterostomy (Table II); there appeared to be relatively few cases in which a direct attack on the ulcer was called for. There were 18 cases in which, usually because of hæmorrhage, it seemed advisable to adopt a more radical procedure than simple gastro-enterostomy. The procedure in such cases rests with the surgeon, the excision and pyloroplasty of Finney, Horsley, C. H. Mayo, and Judd, being outstanding in value. In 4 cases of duodenal ulcer, partial gastrectomy and duodenectomy were employed. While it is difficult to understand the rationale of partial gastrectomy as a primary operation for chronic duodenal ulcer,

it is nevertheless imperative, in view of the enthusiasm of continental surgeons for such radical treatment, to investigate its possibilities. Although the operation entails but little more risk than gastro-enterostomy, this fact alone does not recommend it, and it is doubtful whether the end-results will show that it has any superiority over less mutilating procedures. There is already evidence of a reaction against the removal of a large part of a healthy stomach as an indirect method of treating a benign lesion not in the stomach.

TABLE II.—OPERATIONS FOR DUODENAL ULCER AND ITS COMPLICATIONS

Types of operation	Cases	Hospital mortality
Partial gastrectomy and duodenectomy	4	
Partial gastric exclusion (Devine)	4	
Posterior gastro-enterostomy	142	
Antecolic posterior gastro-enterostomy	1	
Excision with or without gastro-enterostomy or gastroduodenostomy	9	1
Disconnection of the anastomosis, excision, pyloroplasty	1	
Total	161	1

Retention vomiting following gastro-enterostomy is rare, since mechanical difficulties are practically eliminated if the operation is indicated, the opening is of sufficient size, the proximal loop of the jejunum is long enough, and the anastomosis hangs well below the mesocolic opening. If regurgitant vomiting should occur, it is usually controlled by systematic gastric lavage and, if necessary, intravenous medication to maintain body fluids.

Gastric ulcer. It is apparent that partial gastrectomy is becoming more and more the operation of choice in cases of chronic gastric ulcer (Table III). The operation is safe, and complete removal of the lesion is insured. Another advantage worthy of note is that the removal of multiple ulcers is also insured. These are more common than has been believed, and undoubtedly supposed recurrences following excision and gastro-enterostomy have been lesions that were not removed at operation because they were not detected at that time. The tendency of gastric ulcer to become malignant has been shown with such certainty in some of these cases that attempts to depreciate the danger of this tendency are both unnecessary and unwise. It is still not realized that gastric ulcer is a rare disease; and the frequency with which such a diagnosis is made, particularly in women, may explain why certain observers believe that only a small percentage of them develop into malignant processes.

While partial gastrectomy is the method of choice in cases of chronic gastric ulcer, local excision by knife or cautery, combined with gastro-enterostomy, remains the most satisfactory and the most reasonable procedure for the small lesion which can be accurately mobilized. Ulcers attached posteriorly should, whenever possible, be at least detached and the edges of the opening excised or destroyed with cautery, since indirect operation alone will relieve symptoms in only a small percentage of cases, and the danger of subsequent malignant change is a very real one.

TABLE III.—OPERATIONS FOR GASTRIC ULCER AND ITS COMPLICATIONS

Types of operation	Cases	Hospital mortality
Partial gastrectomy	29	
Posterior gastro-enterostomy	7	
Excision (knife or cautery) and posterior gastro-enterostomy	18	
Knife excision	1	
Closure, perforation, and drainage	1	
Anterior gastro-enterostomy, entero-anastomosis	1	
Jejunostomy	1	1
Total	58	1

It should be remembered, however, that gastro-enterostomy alone can be depended on in a certain percentage of cases to promote healing of the ulcer and consequent relief from symptoms. The case of a young woman, 27 years of age, who had a typical syndrome of gastric ulcer of the hæmorrhagic type illustrates this point. At operation the lesion with a crater 4.5 centimeters in diameter was found on the posterior wall of the cardiac end of the stomach with a broad attachment to the pancreas. It was quite obviously unwise to attempt removal as it would have necessitated almost total gastrectomy, and posterior gastro-enterostomy only was performed. Six months later the patient returned, the peptic ulcer pain having gradually disappeared. An X-ray examination showed no evidence of a lesion.

Of the 57 cases in this group there were 10 with multiple ulcers, and 3 with hour-glass

contraction. In practically all cases the ulcer was situated on the posterior wall near the lesser curvature. There were only 10 cases in which the ulcer was not removed either by excision or by partial gastrectomy, removal being accomplished, therefore, in 83 per cent. One case in which the ulcer was not excised was that of a patient, aged 75 years, who had a high-grade pyloric obstruction. He had been operated on previously for an acute perforating ulcer. Relief from the obstruction was the urgent indication, and apparently nothing was to be gained from a resection of the indurated area at the pylorus. The other cases in which an indirect operation alone was done were more or less similar, that is, large posterior ulcers situated high in the stomach, and associated with such extensive perigastritis and thickening of the gastric wall that, even had the general condition of the patient been satisfactory, only the indirect operation would have been justifiable.

The one death in the series of cases of gastric ulcer might reasonably be attributed to some other cause than the operation for ulcer, since the condition of the patient and the size and character of the lesion made any operation for the ulcer out of the question. As the patient was rapidly failing because of his inability to eat, a jejunostomy was done in the hope that by feeding for several weeks through the tube, improvement would be sufficient so that operation for the ulcer could be performed. The operation was performed under local anæsthesia and the patient recovered from it, but at the end of a week he developed bronchopneumonia. Because of his low resistance, he did not recover.

Gastric carcinoma. The surgical management of carcinoma of the stomach involves many important phases, and only some of the more practical ones will be considered here. First it should be noted that the percentage of resectability is about the same in recent cases as it has been in earlier cases in the clinic, namely, 42. Since it is the practice in the clinic, if the patient desires it, to perform an exploratory operation for carcinoma of the stomach without evidence of metastasis, and the total number of operations included an unusually large number of explorations, a rate of resectability of 42 per cent is not low. This rate is only attained by performing a certain number of rather questionable resections, and in some cases of this series it seems almost necessary to apologize for attempting resection because the disease was so advanced. If, however, one is governed by the wish of the patient and follows the Golden Rule, occasional extensive resections for advanced carcinoma are inevitable. Experience has shown that some of these patients have remained well and free from recurrence. Again, partial gastrectomy may be undertaken as a purely palliative measure, that is, in the presence of known metastasis, the growth being resected for actual or impending obstruction. Since resections have been performed on patients with all stages of involvement, a series in which partial gastrectomy was performed 46 times for carcinoma with 1 death shows how safely such operations can be carried out (Table IV).

It will be noted that gastro-enterostomy was performed comparatively rarely in cases of gastric carcinoma. Gastro-enterostomy for advanced carcinoma seldom gives sufficient palliation to make it worth while, and is often disappointing from every standpoint. All the resections were done in one stage; however, a two-stage operation, as pointed out by Crile, is occasionally of value.

TABLE IV.—OPERATIONS FOR GASTRIC CARCINOMA

Types of operation	Cases	Hospital mortality
Partial gastrectomy	46	1
Exploration	48	
Posterior gastro-enterostomy	15	
Anterior gastro-enterostomy	2	
Anterior gastro-enterostomy and entero-anastomosis	2	
Total	113	1

Proper pre-operative preparation will usually make primary resection possible if it can be done at all. Finally, the methods of resection employed show that in 50 per cent it was apparently safer and easier to re-establish continuity by an antecolic end-to-side anastomosis, adding to this, in all cases except one, an entero-anastomosis. The Billroth I operation or its modification is not suitable because in planning a direct approximation of stomach

TABLE V.—OPERATIONS FOR RECURRING ULCER AND ITS COMPLICATIONS

	Cases	Hospital mortality
Duodenal ulcer		
Resection	2	
Posterior gastro-enterostomy	11	
Excision and gastroduodenostomy	1	
Disconnection of the anastomosis following gastro-enterostomy, excision of scar, pyloroplasty	1	
Gastric ulcer		
Resection	5	
Excision and pyloroplasty	1	
Posterior gastro-enterostomy	1	
Gastrojejunal ulcer (including gastrojejunocolic fistula)		
Resection	16	1
Disconnection of the anastomosis following gastro-enterostomy, posterior gastro-enterostomy	1	
Disconnection of the anastomosis following gastro-enterostomy, with or without excision of ulcer and pyloroplasty	5	
Total	44	1

TABLE VI.—PARTIAL GASTRECTOMY

Diagnosis	Cases	Hospital mortality
Carcinoma	46	1
Gastric ulcer	29	
Duodenal ulcer	4	
Combined gastric and duodenal ulcers	9	
Recurring duodenal ulcer	2	
Recurring gastric ulcer	5	
Gastrojejunal ulcer	16	1
Sarcoma of the stomach	1	
Hypertrophy of the pylorus	1	
Malfunction of the anastomosis following gastro-enterostomy	1	
Total	114	2

and duodenum, the surgeon is necessarily interested in getting a safe approximation and may therefore not resect the growth as widely as when such a consideration does not enter into the problem. If recurrence does take place, it usually occurs in the line of anastomosis, probably with resulting obstruction.

It may be of interest that chromicized catgut was employed for all sutures, two rows being placed posteriorly and three anteriorly. Particular attention has been paid to emptying the stomach thoroughly by suction just before the anastomosis is closed.

The relation of carcinoma to ulcer is well shown by the history of a patient, aged 55 years, who had had stomach trouble for 15 years. The history was typical of peptic ulcer in its periodicity and in the relation of pain to food. Two months before examination at the clinic the patient had vomited coffee-ground material and had developed symptoms of partical obstruction. During these 2 months he had lost 20 pounds. Examination of gastric contents showed total acids 70, and free hydrochloric acid 50. A clinical diagnosis of ulcer of the stomach was made. Exploratory operation revealed an ulcer of the posterior wall, about 2 centimeters in diameter, attached to the pancreas. Resection was performed and the patient recovered uneventfully. The pathologist reported "early carcinomatous degeneration." A year later the patient returned, having had several months of complete relief from his gastric symptoms, but he had recently noticed a loss of weight with loss of appetite. On examination he was found to have multiple carcinomatous nodules on the abdominal wall with ascites and abdominal carcinomatosis.

Recurring peptic ulcer. Recurring peptic ulcer, although relatively rare following the proper surgical treatment, is nevertheless an important phase of peptic ulcer because of the failure of surgery to bring about permanent cure, and because of the difficulties surrounding the cause, prevention, diagnosis, and management of the complication. The scope of this paper will not permit any detailed discussion of ulcers of this type, but it should be said that if the primary operation is properly carried out, is based on adequate indications, and the patients make a reasonable effort at co-operation in their habits of living after the operation, recurrences will be so few that one will hestitate to depart from the methods of surgical management which have been in vogue for so many years. Recurrence may and does, of course, follow any type of operation, including partial gastrectomy. In this series there were 44 operations for recurrences (Table V): 22 of these were at the point of gastro-enteric anastomosis, 7 were in the stomach (6 following gastro-enterostomy and 1 following gastroduodenostomy), and 15 were in the duodenum (7 following a closure of an acute perforation, 4 following an excision of the ulcer and gastroduodenostomy, 2 following gastro-enterostomy, and 2 in which the details of the previous operations could not be determined).

HYPERTHYROIDISM IN CHILDREN

By ROBERT S. DINSMORE, M.D., Cleveland, Ohio
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THE incidence of hyperthyroidism in children, as has been pointed out by Hyman, is probably higher than would be supposed from the comparatively small number of cases which have been reported in the literature. In all of the 48 cases here reported the patients were under 14 years of age.

Buford in a very exhaustive review of both foreign and American literature found only 8 cases of exophthalmic goiter in children under 5 years of age and only 18 cases in children under 12 years of age in a total series of 1,512 cases. In 1913, Lewis, of the Mayo Clinic, reported 5 patients all under 10 years of age. In none of these series was there a male patient. In 1923, Cowden, who had gone over the literature on this point, noted that exophthalmic goiter had not been reported in a male child under 10 years of age. In a series of 3,477 cases, Klein reports only 154 under the age of 15, and in this series the males were above 12 years of age. Bram, who has had a very large experience in treating exophthalmic goiter, reports a series of 43 patients under the age of 15, his youngest patient being just past her fifth birthday. Barrett reports 1 patient only 2½ years of age. In 1912, White reported a case of congenital Graves' disease and Klaus, in 1914, reported the presence of hyperthyroidism in an infant of 9 months.

In our series 1 patient was 5½ years old; one, 7, although the onset of the disease could be definitely placed at the age of 3; 2 were 8 years of age; 2, 9; 3, 10; 4, 11; 3, 12; 13, 13; and 17, 14 years of age. Among the males 6 were 14, and 2 were 11 years of age.

It has been difficult to find a definite etiological factor to which hyperthyroidism

Fig. 1. Hyperthyroidism in child 7 years of age. At left, patient at age of 2 years before development of hyperthyroidism. At right, appearance of patient on admission to clinic. Father had exophthalmic goiter, mother adenoma of the thyroid. Syndrome of hyperthyroidism followed attack of whooping cough at age of 3 years; bilateral exophthalmos; smooth cylindrical enlarged thyroid gland; bruit and thrill; pulse 120.

Fig. 2. Hyperthyroidism in child 10 years of age. At left, patient at age of 6½ years, before development of hyperthyroidism. At right, appearance of patient on admission to clinic. Duration of hyperthyroidism, 1 year. Three sisters with goiter; patient extremely nervous; had taken iodine for 1 week in each month for 9 months; was easily fatigued; parents had noticed prominence of eyes and rapid heart; bilateral exophthalmos; bilateral enlargement of thyroid with bruit and thrill was present; the heart was enlarged at the left; the pulse rate was 118. Ligation was followed by reactions; thyroidectomy was performed with secondary closure.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Hyperthyroidism in child 9 years of age. Mother had hyperthyroidism. Child had pus in urine and was treated for urine infection for 8 months; this was followed by bulging of the eyes and enlargement of the neck; dyspnœa on slight exertion; pulse 130. Very ill after thyroidectomy.

Fig. 4. Hyperthyroidism in child 10 years of age. Child always nervous and irritable; had slight difficulty in speech; thyroid enlarged with bruit and thrills; nervousness, tachycardia, emaciation; exophthalmos developed 9 months after symptoms were first noticed. Interval of 3 months between ligations and between second ligation and lobectomy; every operative procedure followed by marked reaction.

Fig. 5. Hyperthyroidism in child 9 years of age. Soft bilateral enlarged thyroid with thrills; nervousness; marked tremor; pulse 120; exophthalmos had been present for 1 year before examination. Bilateral ligation of the superior thyroid artery and thyroidectomy were followed by marked reaction.

in children could be attributed. Climenko reports a series of cases in one family in which the mother, two daughters, and a child of each of the daughters, one a boy and the other a girl, had the disease. The mothers of 8 of our own patients had had goiters, and in at least two instances hyperthyroidism had also been present; in the case of one of the mothers, who had shown symptoms of hyperthyroidism, the goiter had developed during pregnancy. In 2 of the cases in which the history states that the mother had had a goiter, the fathers had also had goiters, one of them being of the exophthalmic type.

Klein reports 3 cases in which hyperthyroidism followed the removal of tonsils and Wheelon reports the case of a child of 4½ years, in whom exophthalmos with status thymolymphaticus followed varicella and mastoiditis; prominence of the eyes developed rapidly during the attack of chicken pox and the typical syndrome of hyperthyroidism followed. In only a few of our cases is there any history of a directly antecedent infection. In 1 case the patient when 3 years old had had an attack of whooping cough accompanied by very marked convulsions. Soon after this attack a bilateral exophthalmos with tachycardia developed and these symptoms persisted until the child was brought to us at the age of 7 (Fig. 1). In another case, a girl of 9 years, a bilateral exophthalmos appeared 3 weeks after an attack of scarlet fever. In 2 cases there was a history of tonsillitis in 1 of

Fig. 6. Hyperthyroidism in child 13 years of age. Patient has had goiter since birth; no symptoms until 6 months ago; developed nervousness, rapid heart, and lost 40 pounds following an attack of grippe; exophthalmos and tremor; bilateral nodular goiter; pulse 120; basal metabolism rate, +56 per cent.

which the hyperthyroidism was very definitely increased during an attack. In another case, a child of 8 years, a visit to the dentist was followed by a "nervous breakdown," accompanied by nausea and vomiting which necessitated her remaining in bed for 3 days, after which a bilateral enlargement of the thyroid developed with bruit, thrills, and a pulse rate of 134.

The question as to whether iodine may produce an induced hyperthyroidism is raised by its widespread use in the schools for prophylactic purposes. Hyperthyroidism, which may be due to this cause, does occur, but fortunately, in a very small percentage of cases. Marine and Kimball report that among 4,415 school children who received this treatment, hyperthyroidism developed in only ½ of 1 per cent and that in these cases the condition disappeared promptly when the iodine treatment was discontinued. DeQuervain reports the interesting case of a child of 9 years who had a small goiter which was unaffected by the weekly administration of 5 milligrams of iodostarine. When the dosage was increased to 1.75 grams of iodine weekly, the goiter diminished in size but symptoms of marked hyperthyroidism appeared—tachycardia, loss of weight, and extreme nervousness. When the iodine was discontinued, these symptoms disappeared, but the goiter again began to increase in size. De Quervain believes that the risk from iodine in these cases is almost nil if the dose does not exceed 3 milligrams. The effect of large doses of iodine was illustrated also in one of our cases, a girl of 14 years who for four months had received excessive doses of iodine. During this time a marked hyperthyroidism developed which persisted in spite of the discontinuance of the iodine. When we saw her 6 months later, the hyperthyroidism was still very marked, she was extremely nervous, and had a very rapid pulse.

As has been noted above, in most of the cases in our series there has been no familial history of goiter, of thyroid enlargement, or of infection, and in most of the cases the illness has lasted for months rather than for years.

Our observations regarding the sequence of symptoms in these cases conform with those of Burnett, namely, nervousness, followed by enlargement of the thyroid gland, with tachycardia and exophthalmos. The nervousness and irritability of the children are usually the characteristics first noticed by the parents. Some writers have contended that exophthalmos in these children is a rare symptom; in a series of 39 cases, Barrett reported that exophthalmos was present in only 8. This has not been our experience.

Griffith has pointed out that tremor occurs less frequently in children than in adults, but Klein thinks that tremor usually follows the appearance of the tachycardia and irritability. Tremor was noted in 25 of our 48 cases.

Sixteen of the children in our series showed loss of weight; 1 child of 14 years lost 20 pounds, and 2 others, both 13 years old, each lost 13 pounds. Many of these children, however, show no change in weight so that this is not a constant symptom.

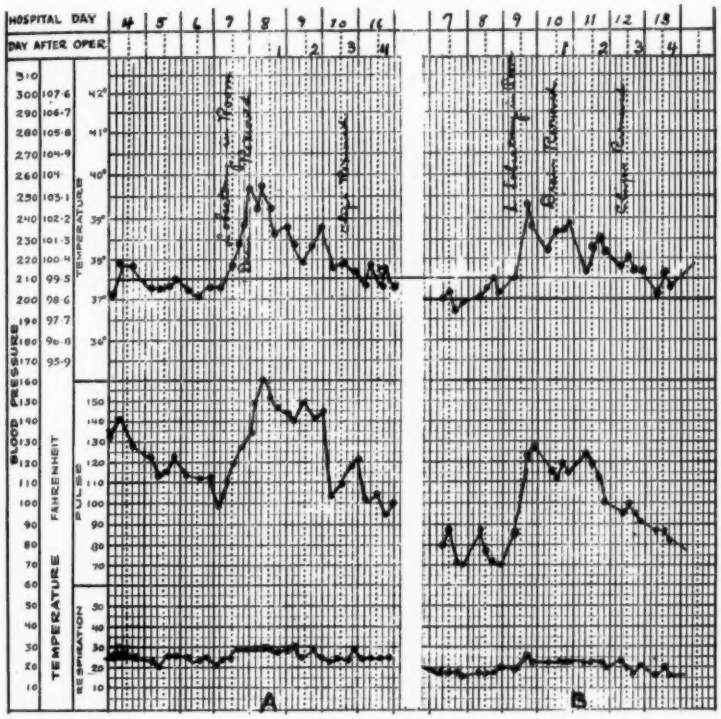

Chart 1.

Chart 1. Chart showing reaction following successive lobectomies. A (left). First lobectomy. B. Second lobectomy, 5 weeks later.

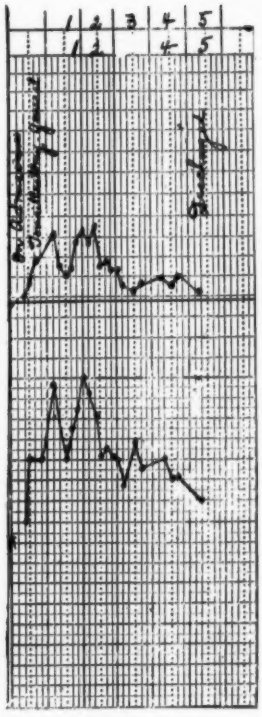

Chart 2.

Chart 2. Chart showing severe reaction following tonsillectomy performed in the presence of hyperthyroidism in child 13 years old.

The highest pulse rate observed in our series was 162, the average for these cases being 125.

So far as we have been able to note, the mentality of these children has been normal for the age, an observation which is in accord with that of Klein.

A study of recent literature pertaining to the determination of basal metabolism in children shows a considerable divergence of opinion as to what may be considered the normal rate for different pre-adolescent and adolescent ages. One of the most recent studies is that of Cameron who has reported an investigation extending over 3 years, as the result of which he concludes that the results by Benedict and Talbot on the basis of body weight are too low for the children of Winnipeg. He attributes this difference to the type of machine used and to the possibility that a climatic factor is involved. Benedict advises that estimations of basal metabolism in children be made on the basis of height rather than weight. Cameron used weight in his estimations of all pre-adolescent children. As stated by DuBois, it is obvious from the variations in the findings of these observers that "much more work on the subject is needed." In view of the difficulties of controlling children, especially the hyperexcitable child with hyperthyroidism, and of the present uncertainties as to the best method to employ, it is obvious that estimations of the basal metabolism in children should be interpreted on the basis of normal estimations secured by the same observer.

The treatment of hyperthyroidism is the same whether the patients are children or

adults excepting that it should be borne in mind always that especial care must be exercised in handling these children as they are very susceptible to every form of stimuli and may be very ill after the operation. While cases of acute hyperthyroidism may occur, I believe they are of rare occurrence. In nearly all our cases certainly, the condition was chronic and such cases are never cured, I believe, unless the gland is removed. Eleven of our cases were not operated upon. These included one case in which hypopituitarism was present and treatment was directed to that condition; 7 in which a period of "watchful waiting" was advised, one in which we felt that a preliminary tonsillectomy and adenoidectomy were indicated, and 2 cases of induced hyperthyroidism which cleared up when the administration of iodine was discontinued. As these children are all very poor operative risks the same careful handling is required as in severe cases in adults. In nearly every instance it is necessary to ligate the superior thyroid artery, first on one side and a few days later on the other side, 3 months before the thyroidectomy is performed. The reaction, even to the ligation, is often very marked. Chart 1 shows the reaction following a thyroidectomy in a child 8 years old. In the latter case the child was extremely ill for 48 hours but later made an uneventful recovery.

The presence of foci of infection and their removal brings up an important point in the management of these cases. We have found that invariably the child will obtain greater benefit from the thyroidectomy than, for instance, from the removal of the tonsils, and we have found, moreover, that a tonsillectomy performed in the presence of severe hyperthyroidism is apt to cause a very severe reaction. This is illustrated by Chart 2. We have therefore concluded that in severe cases, the goiter should be removed first, the removal of foci of infection being deferred until after the child has recovered from the thyroidectomy.

CONCLUSIONS

Hyperthyroidism in children is perhaps more common than has been supposed, and reported cases will undoubtedly appear more frequently in the future.

The etiology is unknown. A small percentage of the cases reported in the literature and in our own series, followed acute infections but ordinarily there is no tangible factor to which the disease can be attributed. The onset is abrupt and the clinical course rapid. Induced hyperthyroidism may follow the prophylactic use of iodine in a very small percentage of cases but this can usually be controlled by the discontinuance of the iodine.

These children are extremely susceptible to all kinds of operative procedure and must be handled with extreme care.

In the presence of other foci of infection, the goiter should be removed first, the other foci of infection being removed after the patient has recovered from the thyroidectomy.

THE CARE OF THE HANDICAPPED GOITER PATIENT[1]

By ROBERT S. DINSMORE, M.D., Cleveland, Ohio
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In considering methods for the rehabilitation of handicapped goiter patients one should have clearly in mind the groups of cases in which operation is peculiarly hazardous and the fact that whatever the type of case the same general measures for restoration and conservation are in the main effective. The groups of goiter cases in which the hazard of operation is especially marked are: first, cases of hyperthyroidism in adults in whom symptoms of the disease are outspoken and of long standing; second, all cases of hyperthyroidism in children; third, cases of adenomata in elderly patients, with or without hyperthyroidism; and fourth, cases of large intrathoracic goiter.

The principal conditions which contribute to the risk which attends hyperthyroidism are (1) marked loss of weight within a short period of time; (2) myocardial changes; (3) dehydration and impending acidosis; and (4) instability of the nervous system. Each of these conditions in itself suggests the method of rehabilitation to be employed. Thus the excessive metabolism which has resulted in the rapid loss of weight demands absolute rest in bed with control of the hyperactive nervous system by sedatives. Dehydration and impending acidosis with the attendant vomiting and diarrhœa are met by the administration of large quantities of fluid which we prefer to give by means of the subcutaneous infusion of normal saline to which novocain has been added as suggested by Bartlett. When delirium develops in a patient with acute hyperthyroidism we are confronted with one of the most difficult problems encountered in this disease. The transfusion of whole blood is a very effective remedy and often results in immediate improvement, and we have had instances in which the patient became rational following the transfusion. In some of these cases, however, a true psychosis may develop; if that occurs a guarded prognosis should be made both as regards the risk of operation and the ultimate result. In such cases I feel that a minimum period of 2 months should elapse before any operative procedure is undertaken.

To protect the myocardium, digitalis is given before operation to patients in whom myocardial changes have developed—a measure which was first proposed by Dr. Frank Gibson in 1920. It should be borne in mind that in many cases of hyperthyroidism there has been persistent tachycardia for a long period of time with resultant hypertrophy and dilatation of the heart, and that these cases are especially subject to auricular fibrillation. It should be emphasized, however, that digitalis cannot control tachycardia and that massive doses of digitalis should not be given. Patients who have received pre-operative treatment with digitalis have a much smoother postoperative cardiac convalescence and are certainly less apt to develop postoperative auricular fibrillation. While it is quite true that patients may have postoperative auricular fibrillation without any further cardiac embarrassment, nevertheless, I am always anxious in such cases inasmuch as some of the patients develop a dilatation of the heart. Our routine method is to give 30 minims of the tincture of digitalis every 4 hours for 6 doses, so that the patient receives 180 minims during a period of 24 hours.

Lugol's solution has proved to be an extremely important addition to the preparation for operation of patients with true exophthalmic goiter of the hyperplastic type, and we are indebted to the Mayo Clinic for having brought this measure to our attention. As a result of its use we have been able to perform thyroidectomies as a primary operation in many cases which otherwise would have required preliminary ligations. There are certain points regarding the use of Lugol's solution, however, which should be considered. Early in its use it was frequently noted that patients appeared to be in better condition than was actually the case, as has been pointed out by Lahey, so that it was found to be inadvisable to operate at the time of the

[1] Presented at the Clinical Congress of American College of Surgeons, Philadelphia, October 26–30, 1925.

apparent maximum improvement. In a personal conversation with me, Dr. Pemberton stated that because of some reactions that had occurred when he had operated during this period of apparent maximum improvement he has made it a rule to delay operation until 4 days after the apparent maximum improvement is noted. This has been our experience also. In our uncomplicated cases the period of maximum improvement after the administration of Lugol's solution has appeared at about the eighth day. The optimum time for the operation, therefore, is on the twelfth day. In a certain group of patients, even after this interval, there is a question as to whether or not the lobectomy can safely be performed. These cases emphasize the value of a "trial ligation." If no reaction follows the ligation, then the lobectomy can safely be performed. Our experience has been also that it is most advantageous to perform the operation after a single course of treatment with Lugol's solution as it may be extremely difficult to reproduce the same status after successive courses of treatment. I wish to call attention to Dr. Donald Guthrie's excellent editorial on the use of Lugol's solution, which appeared recently in this journal.

The second group of handicapped goiter patients, namely, children with hyperthyroidism must be handled with especial care. Hyperthyroidism in children is characterized by an abrupt onset and usually a short clinical course. Even after the most careful and painstaking preparation they are apt to react seriously to any operative procedure. Often both the local and the general anæsthetic, even if the latter is not carried beyond the stage of analgesia, have a bad effect on these children. Therefore the operation should be so planned as to require a minimum amount of the anæsthetic, and the surgeon should be prepared to interrupt the operation at any moment. Excellent results often follow ligation in these cases, the improvement often being far more striking than that seen in adult patients. A special word of caution should be offered regarding the danger of performing a tonsillectomy in the presence of hyperthyroidism in children, as the reaction may be much more severe even than that which follows the thyroidectomy. In these cases it should be the routine procedure to perform the thyroidectomy first.

As for the third group of handicapped goiter patients, elderly people with adenomata of long standing, the precautions and special measures outlined above for the protection of patients with hyperthyroidism are equally applicable to these cases.

As for the fourth group, patients with intrathoracic goiter, one point which is of especial importance is concerned with the postoperative care, that is, danger from the extravasation of blood in the mediastinum. Unless the surgeon is perfectly sure that there is complete hæmostasis, the cavity should be packed with gauze and a secondary closure made. In this connection it should be added that after any thyroidectomy the control of wound secretion is very important. For myself I prefer to put in a small gauze drain which is removed at the end of 10 or 12 hours, never allowing it to remain longer than this period, as the charts of these patients show that in some cases at the end of 8 hours the pulse rate begins to increase and the temperature to rise. Both drop, however, just as soon as the drain is removed, since during the first period the gauze absorbs the wound secretion while after that time it becomes in effect a dam.

A general discussion of the various postoperative complications which may occur is not within the scope of this paper, but I do wish to mention postoperative tetany. Fortunately, this is of infrequent occurrence but it is very distressing when it does occur. The first symptoms of the condition may be a circumoral pallor accompanied by slight tingling of the hands and feet, and nervousness. These symptoms are usually transient and are limited to two or three attacks. In a small number of these cases, however, generalized tonic convulsions develop with characteristic contractures of the hands and feet and occasionally with laryngeal stridor. In the treatment of this condition we formerly gave an intramuscular injection of 20 cubic centimeters of a 25 per cent solution of magnesium sulphate. This always produced relaxation, but, on the other hand, when convulsions occurred we could be reasonably certain that

they would recur on successive days, so that the dose of magnesium sulphate had to be repeated. We now use a parathyroid extract prepared according to the method developed by Professor Collip of the University of Alberta which has proved to be a specific in the treatment of this condition. Only one or two intramuscular injections of 1 cubic centimeter each of the parathyroid extract is sufficient, whereas large and repeated doses of magnesium sulphate are required. Moreover, we have found that parathyroid extract has been equally effective in the treatment of some cases in which the tetany had persisted for a number of years, and, strange to say, in both acute and chronic cases there has been no reduction in the calcium content of the blood.

CONCLUSION

In conclusion, it is my belief that by the employment of absolute rest in bed with sedatives, of large quantities of fluid, of blood transfusions especially in delirious patients, of Lugol's solution, of guarded doses of digitalis, of local anæsthesia, with light gas-oxygen anæsthesia or analgesia, of a multiple stage operation performed in the patient's room, the handicapped goiter patient has the advantages of manifold measures for his protection.

THE REHABILITATION OF THE CARDIOVASCULAR PATIENT[1]

By FRANK H. LAHEY, M.D., F.A.C.S., and BURTON E. HAMILTON, M.D., Boston, Massachusetts

OUR experience with reconstruction of patients with chronic cardiovascular disease has been gained purely from clinical effort to relieve or delay disability of individual patients. We have not adopted any particular therapeutic agent and applied it universally.

Cardiovascular disability, of course, includes in its great variety of disorders some conditions which require or suggest a specific treatment, for example, special drug treatment of the patient with auricular fibrillation, and, rarely, other more dramatic measures such as removal of the cervical sympathetic ganglia, periarterial sympathectomy, embolectomy, and resection of the ribs over a grossly enlarged heart.

In the majority of cases, however, chronic cardiovascular disease is determined by a fixed end-result pathology not to be directly approached. Treatment is forced toward removing coincident burdens such as weight reduction of the obese, removal of evident foci of infection, and adjustment of habits, drugs, diet, hygiene, and living conditions. We feel that adequate care of the patients demands an individual treatment based primarily on direct personal diagnosis, laboratory diagnosis alone and routine treatment being insufficient.

We realize that our enumeration of these well-known therapeutic considerations may appear like platitudes, and risk the obvious inadequacy of this introduction to the vast subject of reconstruction of patients with cardiovascular disease in order to avoid the impression that we overvalue the single important new point of view that our experience has brought us, that is, the removal of coincident surgical burdens.

We wish to stress particularly the operability of these patients. They may be operated upon under certain conditions with surprisingly low mortality.

Of 136 cases with serious rheumatic heart disease personally examined by us and followed through major surgical operations (partial thyroidectomies, abdominal section, and herniotomy), 6 died. The group includes a majority with mitral stenosis, a fair number with aortic regurgitation or both of these lesions, 31 with auricular fibrillation, and 36 with clear evidence of decompensation. One death only occurred in 87 operative cases of

[1] Presented at the Clinical Congress of American College of Surgeons, Philadelphia, October 26–30, 1925.

this group with severe rheumatic heart damage, but with neither auricular fibrillation nor failure.

Of 67 operative cases with hypertension, regular heart beat, and enlargement of the heart secondary to the hypertension, 1 died. Four had congestive heart failure; 2 had persistent alternation of the heart beat; 2 had had hemiplegias.

Of 37 cases selected for gross enlargement of the heart, or auricular fibrillation or anginal or congestive failure (or combinations of some of these) attributable to cardiovascular sclerosis (obviously very poor cardiac risks), 3 died.

A few cases of clinical cardiovascular lues have been operated upon without a death.

A small group of 22 cases with probable congenital heart disease furnished 4 operative deaths and some unpleasant surprises.

Of 150 cases with established auricular fibrillation (many of these with otherwise badly damaged hearts and with decompensation), there were 6 operative deaths.

A group of more than 100 patients with gross congestive heart failure and thyroid toxicity have been operated upon with 3 deaths.

In all the cases enumerated, the patients clearly had severe cardiovascular disease. No one could wish for them as surgical patients.

Study of the deaths in the whole group shows that those cases with severely damaged hearts, such as mitral stenosis, or aortic regurgitation, but without congestive failure or auricular fibrillation, had a negligible mortality (excepting the small group with suspected congenital heart disease). The distinct impression left with us by most of the dangerous cases, those with failure, auricular fibrillation, or both, is that they have tolerated operative procedures surprisingly well. Most of this group did not have any actual choice of risk. They were disabled and with little chance for improvement. Removal of the apparently significant surgical burden was the only promising chance for improvement.

We wish to stress also the importance of searching such patients for surgically removable burdens. The patients with both thyroid toxicity and congestive heart failure first called our attention to the possibility of relieving cardiovascular disability in suitable cases by surgical removal of a coincident burden. We have reported this extremely gratifying group. It includes many cases hopelessly disabled in spite of prolonged medical treatment, who were returned promptly and safely to full ability by removal of the toxic thyroid. This is a unique group, cardiac capacity being restored so strikingly by the removal of a surgical burden.

In an occasional case of rheumatic heart disease without previous disability, congestive heart failure has developed in the latter months of a pregnancy. The failure has persisted in spite of medical treatment until well after delivery with unexpected satisfactory return of ability following. These cases have suggested to us also the possibility that some other large coincident mechanical burden surgically removable may in occasional cardiovascular cripples be the determining factor in disability.

Exclusive of the thyroid cases, and those with the burden of pregnancy, no single large group of such complicating surgical burdens is to be expected among cardiovascular cripples. We have, however, a small but steadily growing group of such patients improved of disability by the removal of a coincident diseased gall bladder or a large pelvic tumor.

The operability of patients with severe cardiovascular disease is not generally appreciated nor, consequently, the possibilities of indirect surgical treatment. Many of our thyrocardiacs have been disabled for long periods while under the care of excellent physicians before the significance of a toxic adenoma or obscure signs of thyroid toxicity was suspected. Along the same lines histories could be given of cases in which a significantly diseased gall bladder or large uterine fibroid was overlooked or wrongly deemed not operable in the face of an obvious cardiovascular handicap. Experience indeed shows that this point of view is often not appreciated by the man whose position makes him apt to be frequently appealed to for final judgment as to surgical risk and advisability of surgery.

We wish, finally, to stress the need of careful preparation of cardiovascular patients for surgical treatment. We are not fatuous enough

to believe that the severely disabled patient with cardiovascular disease is a good risk in routine surgery. These fragile patients deserve elaborate pre-operative care, and in spite of the most painstaking preparation, a definite number will die unexpectedly and suddenly. The first essential is accurate diagnosis of the cardiovascular condition. We have routinely used indirect methods of diagnosis, urinalysis, kidney function tests, blood chemistry, cell counts, blood pressure, examination of the eye grounds, and so forth. We believe them, however, to be but adjuncts of clinical diagnosis and do not feel that they should be allowed to be the uncorrelated basis for determining operability of patients. We do not believe that any formula based upon these indirect tests will adequately express operability.

Similarly, study of the heart by graphic methods has its direct value as an aid to diagnosis, but does not occupy a prominent place in determining operability. Indirect tests for cardiac function with which we have had considerable experience do not appear to be of great value in this connection.

From our experience, nothing can supplant direct personal diagnosis and daily supervision in estimation and control of dangerous cardiovascular risks. For example, the signs and history of gross congestive heart failure are sometimes confusing, may readily be overlooked, and can only be discovered by careful direct examination and history-taking. Operating within 3 weeks of a congestive failure (even though of brief duration) is something to be avoided, if possible, from our experience. Though we have operated successfully in many cases when signs of congestive failure were still present and on a small number of patients who had chronic "failure of the anginal type," the time has been chosen only when prolonged medical care showed the patient to be at his best in terms not only of laboratory tests and of physical signs, but general welfare, as shown, for example, by the character of the respiration, sleep, and absence of anxiety. Though we have avoided routine digitalization, proper digitalization of patients with auricular fibrillation and associated rapid ventricular rate can readily be shown to reduce cardiovascular disability. This and, rarely, other disorders of the heart are sometimes overlooked at routine surgical examinations. Although routine electrocardiographic tracings will determine the diagnosis in most but not all of these disorders, for example pulsus alternans, the condition of the patient who has disorderly heart action only in attacks can be discovered solely by direct and continued observation.

SUMMARY

To summarize, we wish to direct attention to the occasionally indicated method with which we have succeeded in rehabilitating patients with cardiovascular disease by indirect surgical measures. This consists in the removal of surgical burdens. The order of the greatest degree of accomplishment is removal of the toxic goiter, removal of large pelvic tumors, and removal of troublesome gall bladders.

In view of our low mortality with this type of case, we urge that patients of this group who have coincident and burdensome surgical lesions, after proper consideration and preparation by rest, and partial or complete restoration of compensation, be operated upon and relieved of such lesions. It has been our experience that if there is co-operation between cardiologist, anæsthetist, and surgeon, not only will the mortality in this seemingly hopeless group be surprisingly low, but the degree of restored ability in many cardiovascular cases will be strikingly high.

PREPARATION OF PATIENTS FOR PROSTATECTOMY[1]

By HERMON C. BUMPUS, Jr., M.D., Rochester, Minnesota
Section on Urology, Mayo Clinic

In the care and preparation of patients with prostatic hypertrophy for operation there are four main points to consider: (1) the duration and amount of the obstruction, (2) the indications for and against cystoscopy, (3) the care and treatment of associated infection, and (4) the restoration of impaired renal function to a point compatible with major surgical measures.

Duration and amount of obstruction. The duration of the obstruction is, of course, largely determined by the history, but evidence obtainable from cystograms is more reliable. If the obstruction has existed for only a short time there is slight, if any, deformity of the bladder (Fig. 1). If it is of longer duration, the outline becomes trabeculated and irregular, and is characterized by multiple cellules where the mucosa has projected through the muscle fibers (Fig. 2). When the obstruction is of extreme duration, the bladder tends to become cone-shaped and irregular in outline, and is usually associated with one or more diverticula (Fig. 3). The recognition of the presence of diverticula is important, for if they do not empty, freeing the urine from infection becomes impossible, and when large, their surgical removal considerably increases the operative risk. To make certain of the presence and position of diverticula, cystograms should be taken in triplicate. Two plates exposed with the shadow of the bladder projected from either side will usually show the shadow of the diverticula well beyond the bladder outline. The third cystogram taken after emptying the bladder shows diverticula that do not drain. In the interpretation of such cystograms care must be taken not to confuse the shadow of the elongated dome of the bladder, as it projects beyond the shadow of the body of the bladder, with that of a possible diverticulum. The error is not difficult to make.

The extent of the obstruction is ascertained by the amount of residual urine present. If it is less than 120 cubic centimeters, intermittent catheterization for a minimal period of 10 days is usually sufficient preparation, provided renal function is adequate. If the amount of residual urine is more than 120 cubic centimeters the introduction of a permanent urethral catheter is preferable. This reduces manipulation to a minimum, insures continuous emptying of the bladder, and thus prepares it for the condition which will exist after operation.

Indications for and against cystoscopy. In cases of prostatic hypertrophy cystoscopy should be avoided if possible. The passage of any rigid instrument is bound to traumatize the urethra in such cases. A roentgenogram reveals the presence of stones or diverticula, and rectal examination reveals fairly accurately the size of the gland, so that little additional knowledge would be obtained by cystoscopy. Only in those cases in which the symptoms are out of proportion to the prostatic enlargement is cystoscopy indicated. Such a discrepancy is usually due to one of three causes.

One cause is paralysis of the bladder musculature, the result of a lesion of the spinal cord, in which case cystoscopic examination in the absence of prostatic enlargement reveals trabeculation and atony of the bladder usually associated with relaxation of the urethral sphincter. Occasionally such nerve lesions occur in conjunction with benign hypertrophy, when the prognosis as to functional result following prostatectomy should be most guarded since atonic bladders are slow to heal and suprapubic sinuses irritatingly persistent, while the amount of residual urine may increase rather than diminish as a result of the further injury to the nerves, incident to the operation.

A second cause of discrepancy between physical findings and symptoms is confinement of the hypertrophy to the median lobe. If the prostatic enlargement extends into the bladder rather than the rectum it is not de-

[1] Presented at the Clinical Congress of the American College of Surgeons, Philadelphia, October 26, 1925.

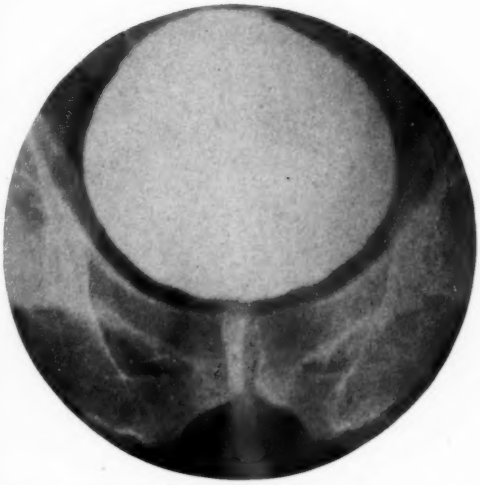

Fig. 1. Cystogram of bladder in which prostatic obstruction has been of only short duration. There is no elevation of the base of the bladder and but little irregularity of the bladder outline.

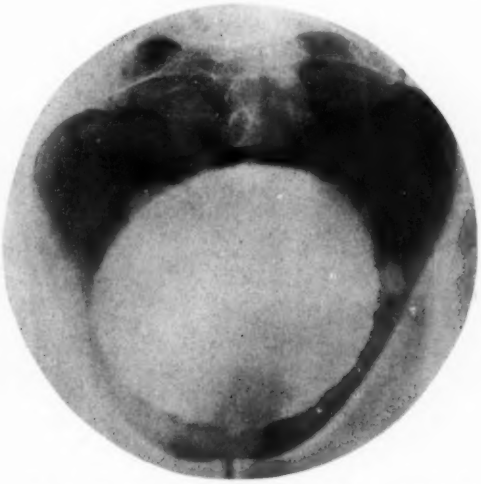

Fig. 2. Cystogram of bladder in which prostatic obstruction has been of several months' duration. Note the irregularity in the bladder outline and multiple cellules, the result of long continued intravesical pressure.

tected on physical examination. Such cases are best treated by removing only the obstructing portion of the gland. This can be most efficiently done by means of the punch operation through the urethra, as the recent improvements in instruments makes possible the removal of much larger amounts of tissue than in the past. Recently we have used this operation in fully a third of our cases of prostatic hypertrophy, and Caulk reports that he uses it in as high as two-thirds of his cases.

The third cause of symptoms out of proportion to the physical findings is prostatic infection. Infection, by increasing the size of the gland, allows the accumulation of sufficient residual urine to increase the infection still further, and so a vicious circle arises. In infected cases removal of the obstructing portion of the gland by means of a punch operation permits of complete emptying of the bladder and thus the infection is rapidly reduced. The performance of a radical operation often so activates the infection that the seminal vesicles and surrounding structures become extensively involved in a very acute process which, of course, produces symptoms of dysuria and frequency as marked as those from which the patient sought relief.

Care and treatment of associated infection. Pyelonephritis is the most common form of infection complicating the preparatory treatment for prostatectomy. Usually of urethral origin it is carried from the prostatic urethra

Fig. 3. Cystogram of bladder in which obstruction has been of long duration. Cone-shaped deformity of dome characteristic of urethral obstruction of long duration, easily mistaken for diverticula.

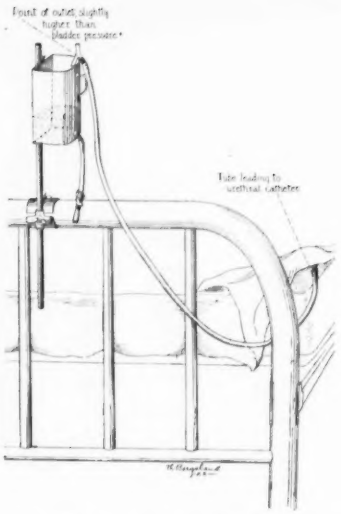

Fig. 4. A simple method of gradually emptying the bladder against a constant pressure.

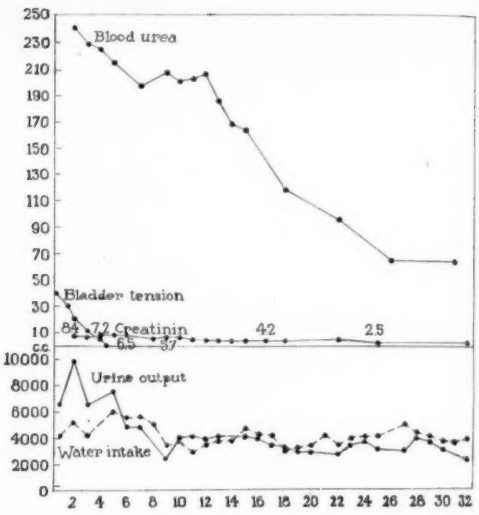

Fig. 5. Chart showing the daily reduction of bladder tension with a corresponding fall in blood urea and creatinin as a result of forced fluid intake, which was more than 4,000 cubic centimeters daily.

through the blood stream to the renal parenchyma where, in fatal cases, multiple small abscesses are discernible at necropsy. During the initial symptoms, consisting of a sudden rise of temperature and chills, colon bacilli can occasionally be cultivated from the blood stream, as pointed out by Cabot. Usually its course is self limited, lasting from 4 to 7 days with decreasing rises in temperature. Numerous drugs, including mercurochrome, methylene blue, acriflavin and hexamethylenamin, have been employed in its treatment, but with the exception of hexamethylenamin, none has proved generally efficient. The administration of the latter is more satisfactory when given intravenously than orally, as doses sufficiently large to produce results will not upset gastric digestion. Mercurochrome given intravenously occasionally yields striking results. The febrile reaction subsides immediately in some cases, but in others it is extremely toxic and has even proved fatal so that its routine use is impossible.

Restoration of impaired renal function. The restoration of the impaired renal function, sufficient to permit of major operations is, naturally, the most important aspect of the preparation of patients with prostatic hypertrophy, many of whom endure urinary obstruction until the renal function as determined by the phenolsulphonephthalein test has reached the vanishing point and the urea content of the blood has reached over 300 milligrams for each 100 cubic centimeters. The establishment of adequate drainage is first undertaken. If the obstruction is complete and acute retention is present, great care must be exercised to empty the bladder gradually. To remove a few ounces at a time is dangerous, as this immediately reduces intravesical tension and so produces œdema of the entire urinary tract. Such œdema within the renal capsule results in diminished output of urine, and the patient is made worse rather than better. Several methods for the continuous gradual emptying of the bladder are in use, the simplest, and I believe the most satisfactory, being the one described by Van Zwaluwenburg (Fig. 4). By this method the urethral catheter is attached to a long tube filled with fluid, and empties into an elevated receptacle at the foot of the bed. The height of this receptacle is determined by the pressure within the bladder, and as this gradually

TABLE I.—BEDSIDE RECORD SHOWING THE GRADUAL REDUCTION OF BLOOD UREA BY THE DAILY INTRAVENOUS ADMINISTRATION OF PHYSIOLOGICAL SODIUM CHLORIDE SOLUTION. TWENTY-FIVE CONSECUTIVE INJECTIONS WERE MADE INTO THE SAME VEIN

Date	Clinic	Colonial	Residual urine, oz.	Bladder lavage	Catheterized times daily	Permanent urethral catheter	Suprapubic catheter	Wound phthalein				Blood Urea	Creatinin	No. c.cm. fluids in 24 hours		Urinalysis			Leucocytes	Hæmoglobin	Blood pressure		Weight	K. U. B.	Cystogram	Intravenous therapy
								Wet	Dry	M.	V.			Intake	Output	Specific gravity	Blood	Pus			S.	D.				
9–10–25		√	7 oz	√		√								400	150				8000	58			147			1000 c.cm. saline
9–11–25		√		√		√						340		2200	900						120	70		Neg.		1000 c.cm. saline
9–12–25		√		√		√					Trace			2800	3400											1000 c.cm. saline
9–13–25		√		√		√								2800	2400											1000 c.cm. saline
9–14–25		√		√		√								1800	1200											1000 c.cm. saline
9–15–25		√		√		√								1800	1000	1009		II								1000 c.cm. saline
9–16–25		√		√		√						158	6.0	4000	3500											1000 c.cm. saline
9–17–25		√		√		√								4000	2700											1000 c.cm. saline
9–18–25		√		√		√								3000	900										"	1000 c.cm. saline
9–19–25		√		√		√					Trace			3200	1500											1000 c.cm. saline
9–20–25		√		√		√								3400	3100											1000 c.cm. saline
9–21–25		√		√		√						122	4.4	2700	1800	1007		I								1000 c.cm. saline
9–22–25		√		√		√								3400	3000											1000 c.cm. saline
9–23–25		√		√		√								2400	2200											1000 c.cm. saline
9–24–25		√		√		√								3100	3000											1000 c.cm. saline
9–25–25		√		√		√						94	3.9	2800	2800											1000 c.cm. saline
9–26–25		√		√		√								2600	3000											1000 c.cm. saline
9–27–25		√		√		√					Trace			2800	2200											1000 c.cm. saline
9–28–25		√		√		√								2800	2500											1000 c.cm. saline
9–29–25		√		√		√								2500	2000											1000 c.cm. saline
9–30–25		√		√		√						84	3.8	2400	2200											1000 c.cm. saline
10– 1–25		√		√		√								2500	2000											1000 c.cm. saline
10– 2–25		√		√		√								3700	3700											1000 c.cm. saline
10– 3–25		√		√		√					5			2800	2600											1000 c.cm. saline
10– 4–25		√		√		√								2800	3200											1000 c.cm. saline
10– 5–25		√		√		√								3600	2700	1010		I								
10– 6–25		√		√		√								4000	3800											
10– 7–25		√		√		√								2600	1800											
10– 8–25		√		√		√						86	3.3	2400	1400											
10– 9–25		√		√		√								2800	1600											
10–10–25		√		√		√					Trace			2400	2100											500 c.cm. blood
10–11–25		√		√		√								2200	800											

diminishes as a result of overflow the receptacle is lowered. Usually from 3 to 4 days are sufficient for complete emptying. After the bladder is emptied the elimination of the retained toxic substances throughout the body is accomplished by the giving of large amounts of fluid and their elimination by sweating, purgation, and diuresis. A careful record must be kept of the fluid intake and output, a minimal output of 2,500 cubic centimeters being imperative. If this cannot be maintained by the oral administration of fluids,

subcutaneous or intravenous administration must be supplemented, preferably the latter, for repeated subpectoral infusions are most trying to the patient and their frequent administration results in costal pain that is most distressing. It has, therefore, been my practice to give 1,000 cubic centimeters of physiologic sodium chloride solution daily intravenously until the desired results relative to urinary output are attained. If care is exercised the same vein may be employed repeatedly, as many as 25 times in succession, from 20 minutes to half an hour usually being required in the administration. Under this form of treatment the amount of urinary infection usually diminishes rapidly (Fig. 5).

Following the administration of fluid, the patient is put daily in a hot pack and a profuse sweat induced. No method has proved as free from danger of burns and overheating as the large electric blanket. The patient can be completely wrapped in this and the current turned off as soon as sweating is initiated. Five or 10 grains of aspirin, given just prior to the pack, or in refractory cases pilocarpine, is a useful adjunct. Under this form of treatment the urea content of the blood usually diminishes in direct proportion to the duration of the prostatic obstruction (Fig. 6). If it has been of long duration, 10 milligrams a day is the average amount of reduction; if of acute onset, from 50 to 100 milligrams is not unusual. When the urea content of the blood has decreased to approximately 100 milligrams for each 100 cubic centimeters, the advisability of an ultimate one- or two-stage operation may be considered.

If the patient tolerates a urethral catheter well the preparation may continue with this form of drainage until the urea content of the blood is below 40 milligrams for each 100 cubic centimeters. If the decrease has been slow and the patient's general condition poor with considerable loss of weight and strength, it is safer to perform a cystostomy and permit him to return home for a few weeks or months, as under home environment and food he gains far more rapidly than in the hospital, once adequate drainage has been established. The two-stage operation has the advantage of insuring considerable diminution in the size of the prostate, since after the urethra is put at rest, the decrease in œdema and engorgement reduces the size of the gland; also the amount of bleeding at the time of operation is much less. However, it compels a blind enucleation, a poor surgical procedure, bound to be followed by a certain number of inferior functional results.

To undertake cystostomy before the urea content of the blood is below 100 milligrams for each 100 cubic centimeters is to diminish materially the possibility of the patient's recovery, as so reduced a renal function will frequently not bear the added load imposed by the operation.

TREATMENT OF THE SURGICAL PATIENT HANDICAPPED BY URINARY OBSTRUCTION[1]

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BELFIELD, in 1890, reported a series of 133 cases from this country and abroad, in which the prostate had been radically removed. He compared mortality rate and ultimate functional results in the suprapubic and perineal methods of removal. Forty-one of the operations were by the perineal method, with a mortality rate of 9.7 per cent; 88 were by the suprapubic method, with a mortality rate of 13.6 per cent; 4 were by the combined method. Restoration of voluntary urination was equally satisfactory following either method, but occurred in only 71 per cent of the cases. The relatively high incidence of failure of the radical operation to restore voluntary urination may be explained on the basis of incomplete removal of all obstructing portions of the gland; in many instances only the median lobe was removed. Lowsley's embryological studies correlated with Wilson's and McGrath's work on the pathology of benign prostatic hypertrophy are supported by clinical experience in showing that prostatic hypertrophy is not confined to the median lobe but occurs at least as often in the lateral lobes with or without involvement of the median lobe. Removal of the lateral lobes when hypertrophied ensures the elimination of all obstructing prostatic tissue, and with the improvement of surgical procedures good ultimate functional results have increased following both the perineal and suprapubic methods of prostatectomy. That unmistakable progress has been made in the perfection of both methods is attested to by the total restoration of voluntary urination after either method as conducted for benign hypertrophy today. While the perineal operation was accompanied by a lower mortality rate in the earlier years of prostatic surgery, improvement in the suprapubic method has apparently eliminated this difference.

Numerous arguments have been presented since Belfield's original report, setting forth the advantages and disadvantages of the perineal and suprapubic methods. However, an unprejudiced analysis of the ultimate functional results and mortality rate following both methods of operation by those experienced in them shows that these indexes of merit can no longer be utilized to discredit one or the other method.

Deaver has shown that the average mortality rate from prostatectomy performed by the occasional or inexperienced operator in this field of surgery is between 20 and 30 per cent. Such a high mortality rate seemed to justify the investigation of the causes of death, an analysis of the factors influencing lethal effect, and the presentation of means of prevention.

In the early years of prostatic surgery little was known of the effects of prostatic obstruction, no methods had been devised for measuring those effects, and no therapeutic means were available for obviating them. However, investigation has resulted in reliable tests of renal function, and experience has taught their application, so that more or less standardized methods have been devised for the more successful management of the patient with prostatic obstruction. Experience has also taught that adequate management embraces more than surgical removal of the gland. As Bugbee has said: "Removal of the prostate gland is but an incident in the treatment of prostatic obstruction."

Since prostatic obstruction occurs most commonly between the ages of 60 and 75 years, far beyond the average age for surgical conditions, the patient must be considered a substandard risk, not only because of his age, but because of the coincident cardiovascular changes, and the renal insufficiency incident to urinary retention. Recognition of these conditions has led to methods of preparation for prostatectomy to enhance the patient's physical and organic reserve, which lessen the

[1]Presented at the Clinical Congress of the American College of Surgeons, Philadelphia, October 29, 1925.

risk of the operation and reduce the mortality rate. Willius has recently shown that 42 per cent of patients with prostatic obstruction have cardiovascular disease, and that the incidence of cardiovascular disease is higher with prostatic obstruction than with many other diseases during similar decades, indicating that co-existing cardiovascular disease is increased by persistent urinary retention.

The causes of death following prostatectomy may be classified in three groups: (1) pre-existing and co-existing organic disease, (2) surgical accidents, and (3) postoperative complications. Group 1 comprises renal insufficiency, cardiovascular disease, chronic pulmonary disease, and diabetes. The most common causes in Group 2 are hæmorrhage, shock, and anæsthetics. Group 3 includes pulmonary complications, general sepsis, embolism, and peritonitis. Experience has shown that many of these causes of death are preventable. In the early years of prostatic surgery many patients were operated on immediately. Urinary retention, due to prostatic enlargement, was regarded and treated as an emergency, and too often prostatectomy was performed without preliminary examination to determine the physical and organic reserve of the patient. Acute urinary retention may at times not be amenable to other than surgical drainage, but prostatectomy is never an emergency procedure. In most instances the careful passage of a urethral catheter is successful and allows sufficient time to ascertain the physical status of the patient, and to determine by what means and at what time permanent relief of the obstruction may be considered. In obstructing lesions of the large intestine with resultant toxæmia, removal of the lesion is of secondary importance to the relief of the obstruction. Likewise, in cases of prostatic obstruction it is primarily important to relieve the obstruction; eradication of the prostate should be considered only after the patient's recovery from the effects of obstruction, with stabilization of his physical and organic reserve.

As co-existing renal insufficiency, cardiovascular disease, and chronic pulmonary lesions are directly responsible for 50 per cent of deaths following prostatectomy, and indirectly responsible for many others due to postoperative complications, their treatment preliminary to operation is essential. Since urinary retention with resultant renal insufficiency and subsequent uræmia in cases of long duration directly affect renal function and secondarily enhance co-existing cardiovascular and chronic pulmonary disease, drainage of the bladder forms the keystone of treatment preliminary to prostatectomy.

PREPARATORY TREATMENT

Determination of the time at which prostatectomy may be undertaken with safety depends on the amount of rehabilitation possible in the individual case as indicated by various tests. The phenolsulphonephthalein test of Rowntree and Geraghty, and the urea content of the blood are accurate indexes of renal function, and relatively easy of conduct and interpretation. The salivary urea estimation, according to Hench and Aldrich, has simplified the determination of urea retention and affords accurate measurement of renal insufficiency, with the simplest of laboratory equipment. Estimation of renal function determines the amount of renal damage incident to retention, acts as a guide to the time at which operation may be considered with safety, and serves as a relative prognosis for recovery and postoperative life. These tests of renal function require repetition at frequent intervals during the period of pre-operative treatment to permit accurate interpretation of the effects of treatment. Except under most unusual circumstances preliminary treatment should be continued until the reactions to the renal functional tests have become stabilized within, or near normal limits. It is only through the employment of these tests that the time may be accurately determined at which operation may be carried out with the minimal risk.

Electrocardiographic studies in conjunction with clinical investigation of the cardiovascular system has become routine in the determination of the status of the patient with surgical prostatic obstruction. The electrocardiogram makes the diagnosis of cardiovascular changes approach an exact science, facilitates estimation of the cardiovascular reserve, and serves in making a relative prognosis.

Careful physical and roentgenographic examination of the lungs may disclose chronic pulmonary lesions, notably chronic bronchitis, bronchiectasis, emphysema, and so forth, which predispose to acute postoperative exacerbation and pulmonary complications.

In the evolution of suprapubic prostatectomy it was a common observation that patients who had survived simple cystostomy for retention or for removal of vesical calculi, and had recovered from the depression, subsequently underwent radical removal of the prostate gland with a relatively low mortality rate. This gave impetus to the two-stage prostatectomy, which is yet indispensable when there are associated vesical lesions, severe cystitis, marked renal insufficiency, senility, intolerance to the urethral catheter, and trauma of the urethra. Prostatectomy simultaneous with removal of large vesical calculi, and excision of large diverticula in the presence of marked cystitis, is accompanied by a higher mortality rate than the two-stage operation. In my experience less than 6 per cent of patients are intolerant to drainage by the permanent indwelling catheter and require cystostomy. The two-stage operation is necessary in certain cases to ensure the minimal risk, but that it deserves adoption as a routine is questionable. Excellent drainage of the bladder is facilitated through permanent urethral catheterization in most instances and limits the surgical procedure to one operation, which permits exposure, visualized conduct of the operation, and accurate hæmostasis, so necessary to the best functional results and avoidance of surgical accidents. Employment of the method of gradual decompression, as described by Van Zwaluwenburg, has often obviated the necessity for preliminary cystostomy.

That drainage of the bladder is the most important factor in preliminary treatment does not necessarily mean that cystostomy should be performed, as attested to by the favorable results of the indwelling urethral catheter. Between January, 1913, and January, 1925, suprapubic prostatectomy was performed in 1,783 cases at the Mayo Clinic. In only 437 (24.6 per cent) was preliminary cystostomy necessary. While the average mortality rate following prostatectomy at the Mayo Clinic for the twelve-year period was 5.5 per cent, the mortality rate for the two-stage operation was 7.5 per cent, as compared to 4.8 per cent for the one-stage operation. The mortality rate following the one-stage operation was lower than the two-stage by virtue of the better general condition of the patients selected for this method, and the mortality rate following the two-stage operation would have been lower than it was had the latter been employed as a routine in all cases. However, as approximately 75 per cent of patients, when carefully selected, may be satisfactorily prepared and operated on by the one-stage method with relative safety, the diluent effect on mortality rate is an insufficient reason for employing the two-stage operation as a routine. Whatever the various opinions regarding the one- and two-stage procedures, drainage of the bladder by urethral catheter or cystostomy permits recovery from renal insufficiency with stabilization of renal function, and decreases the stress on the cardiovascular system and respiratory apparatus.

EFFECT OF PRELIMINARY DRAINAGE

Between January, 1913, and January, 1925, there were 113 deaths following suprapubic prostatectomy at the Mayo Clinic. Fourteen occurred from 30 days to as late as 6 months after operation, but these resulted from conditions existing prior to operation, or from intercurrent conditions to which the operation bore no relation. These cannot be considered as surgical deaths. However, 99 of the deaths occurred within 30 days after operation, and even though it would seem that in some instances the operation was but an incident and had little to do with the death, these are all classified as surgical deaths. Thirty-three of the patients who died had been prepared by suprapubic cystostomy and obviously comprised the group of patients who, on account of associated vesical lesions, marked renal insufficiency, and poor general condition, were the poorest surgical risks; 22 were prepared by permanent or intermittent urethral catheter drainage, and as a group comprised patients who were considered as fair surgical risks; 44 had small amounts of residual urine and no

demonstrable renal insufficiency, and were considered good surgical risks without preparation.

A review of the clinical course and necropsy findings, obtained in 85 per cent, indicates that 50 per cent of the deaths were due to pre-existing and co-existing disease, that is, cardio-vascular-renal disease, and pulmonary lesions; 4 per cent were due to surgical accidents, that is, hæmorrhage and shock; 46 per cent were due to postoperative complications such as pulmonary complications, general sepsis, embolism, and peritonitis. Seventy-five per cent of the deaths occurring in that group of patients considered the best surgical risks by virtue of small amounts of residual urine, no demonstrable renal insufficiency, and so forth, and the operation of prostatectomy undertaken without preliminary treatment, were due to the causes enumerated under Group 1. Thirteen deaths from postoperative complications were due to pulmonary embolism; 11 patients dying from this cause had been considered excellent surgical risks and were operated on without preliminary treatment. That the occurrence of pulmonary embolism bears a distinct relationship to lack of preliminary treatment is beyond question.

In the group of 437 patients (24.5 per cent) who had had preliminary cystostomy the mortality rate was 7.5 per cent for the subsequent prostatectomy; 666 (37.3 per cent) received no preparation and the mortality rate was 6.6 per cent; 680 (38 per cent) had been prepared by urethral catheter drainage and the surgical mortality rate was 3.2 per cent. In other words the mortality rate following prostatectomy on the best surgical risks without preparation approaches closely that of the exceedingly poor risks requiring cystostomy, and is twice that following preparation of patients by urethral catheter drainage.

The necessity for preparation in all cases is apparent, and successful management demands drainage of the bladder preliminary to prostatectomy for at least 10 days, often for longer periods. This has recently been accomplished by permanent urethral catheter, followed by the one-stage visualized suprapubic prostatectomy in 80 per cent of the cases.

The adoption of this principle of management in all cases has resulted in the removal of the prostate gland in 204 cases at the Mayo Clinic during the present year with but 3 deaths, in 172 consecutive cases of which the one-stage operation was employed with but 1 death.

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PHYSIOLOGICAL PRINCIPLES IN THE TREATMENT OF BENIGN HYPERTROPHY OF THE PROSTATE[1]

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INCOMPLETE obstruction, whether in the stomach, intestine, common bile duct, or urinary tract, produces a toxæmia with the accumulation of non-protein nitrogen, such as urea in the blood, due to an increase in the breakdown of the body proteins, or to its retention in the blood stream resulting from the failure of abnormally functioning kidneys to eliminate it. With the toxæmia and accumulation of urea in the blood, the acid-alkali balance may be disturbed with resulting acidosis or alkalosis. These chemical changes in the blood caused by the obstruction, unless recognized and compensated for, may cause the death of the patient. Although the relief of the obstruction, whether it is biliary, intestinal or urinary, is essential to ultimate recovery, it should not be undertaken until the condition of the patient affords a reasonable assurance that an operation may be safely performed.

METHODS OF RESTORATION

The preparation of such patients for operation demands the correction of the function of the kidneys, liver, and intestinal tract, and the control of infection. The neutralization, detoxication, and elimination of the toxic products resulting from the obstruction, are essential. The necessity for maintaining a normal fluid balance in the body is apparent in every type of disease; water in sufficient amounts drunk by the patient allows an interchange of fluids between the body tissues and the blood. It is a solvent and diuretic and is of great value in the elimination of nitrogenous material such as urea and creatinin. The concentration of water in the blood stream affects the regulation of body temperature as shown by Barbour. A diminution of the fluid content of the blood causes a decrease in the oxygen carrying power of the red blood cells by reason of increased viscosity.

The intravenous injection of a 1 per cent sodium chloride solution, which has been used by Bumpus in the preparation of patients with benign hypertrophy of the prostate who are handicapped by disturbance of renal function, not only supplies the blood and tissues with fluid, but increases the number of chloride molecules, which may have a detoxicating effect, as evidenced by the satisfactory control of toxæmia in other types of obstruction and stasis.

The condition of the patient is dependent not so much on what passes from the body by way of the kidney, the intestine, and the skin, as on what remains in the blood and in the tissues. Whereas many years ago the constituents of the excretory products were looked to for an indication of the functional capacity of an excretory organ, we now look to the blood and determine accurately what is being retained in the body.

Sodium chloride solution injected intravenously, usually suffices to control the toxæmia co-existing with prostatic obstruction. It is sometimes advantageous to add glucose, since it is quickly oxidized in the body, to produce heat and energy. This can be done by the continuous intravenous drip suggested by Matas, or by means of repeated injections of a 10 per cent glucose and 1 per cent sodium chloride solution which has been found by McVicar adequately to control the toxæmia resulting from gastro-intestinal stasis. Opie and Alford have shown experimentally that when sufficient carbohydrate is supplied to animals, the effects of chloroform and phosphorus poisoning on the liver cell are considerably lessened. In the case of toxic products of protein disintegration, glucose, besides protecting the cell, probably forms glycuronates with them, in which form they are excreted. It is a reasonable hypothesis that the beneficial effect derived from the intravenous injection of glucose is partly

[1] Read before the Clinical Congress of the American College of Surgeons, Philadelphia, October 26-30, 1925.

the consequence of this detoxication of the products of abnormal protein catabolism. Glucose too acts as a diuretic, and its value in the treatment of toxæmia resulting from biliary retention has been described by Judd and Burden.

Should acute retention of urine in the bladder occur, the necessity for withdrawing the urine gradually is apparent since its sudden removal may be sufficient to cause suppression of urine. The relation between the circulatory pressure and urinary pressure may be disturbed by alteration of either. The renal blood pressure may be reflexly affected by vasomotor influences from the rapidly relieved bladder; the urinary pressure in the tubules may be suddenly altered with release of the excessive pressure in the bladder. If the alteration in the relative pressures on the two sides of the secreting renal cell is sudden enough and profound enough, suppression will result. In addition, the change of the relative pressures on the two sides of the secreting cell is likely to inhibit the function of the cell. The same principle applies in the relief of biliary obstruction. Crile has shown the advantages of slowly relieving the pressure in an obstructed biliary tract by allowing only a gradual escape of bile through the drainage tube. In biliary obstruction resulting from a malignant neoplasm at the head of the pancreas, anastomosis of the gall bladder and the intestine which permits only a gradual release of the obstruction, achieves results far superior to those obtained by external drainage such as cholecystostomy in which the pressure is quicky and suddenly relieved.

With the gradual relief of the obstruction, whether spontaneous or induced, improvement in the patient's general condition is at once apparent. Coincidentally antibodies apparently appear which increase the resistance of the patient. It is a fact that operations performed on debilitated patients, in whom improvement has begun, are attended with as little risk as though complications had not appeared. The appearance of the patient and his opinion as to the condition of his health usually indicate when improvement begins. Also the phenolsulphonephthalein test of Rowntree and Geraghty and an estimation of the amount of urea in the blood, give accurate information concerning the functional capacity of the kidneys. Should the condition of the patient be such as to increase the risk of surgical procedure, then the usual methods of restoration suffice in most instances to prepare the patient for a safe operation.

In order that there may be the smallest possible residue of nitrogen, the diet should consist for the most part of carbohydrates, with a minimum of protein and fat. Although 60 per cent of protein can be metabolized by the body into glucose, the process leaves a residue of nitrogenous by-products which may accumulate in the tissues and in the blood and place additional strain on kidneys the function of which is already unbalanced as a result of obstruction and infection in the urinary tract.

Cabot has said that infection does not develop in a previously clean bladder following catheterization, until overdistention from urinary obstruction occurs. With prostatic obstruction the patient is usually unable to empty the bladder entirely, and the resultant accumulation of residual urine forms an excellent culture medium for bacteria. For this reason it is essential during the preparation of patients with hypertrophy of the prostate, in the presence of urinary infection, to see that the bladder is kept entirely empty either by means of an indwelling urethral catheter which can be satisfactorily used in 75 per cent of cases as shown by Hunt and Bumpus, or by means of suprapubic cystostomy.

The pre-operative treatment of patients with benign hypertrophy of the prostate has materially assisted in the reduction of the mortality rate of prostatectomy. In 204 consecutive operations for prostatectomy performed between January 1 and October 1, 1925, by Hunt and myself, there were three deaths, one of which occurred from facial erysipelas on the thirtieth day following the prostatectomy from causes entirely remote from the operation. For the most part, prostatectomy was suprapubic, with the exception of approximately 10 per cent of my own cases

in which the operation was performed, for one reason or another, by the perineal route.

APPROACH TO THE PROSTATE

In a discussion of any operative procedure, it should be borne in mind that when more than one procedure can be used for the treatment of a surgical condition, the one chosen should be that which can be followed with the greatest degree of safety to the patient and which carries the least risk of unpleasant postoperative complications and sequelæ.

In general there are indications for both the suprapubic and the perineal methods of approaching the hypertrophied prostate, depending on the condition of the patient and the specific pathologic condition of the urinary tract. When routine preliminary preparation of all patients with urinary obstruction is carried out prior to operation and the patient's condition enables him to withstand operation, the risk of prostatectomy is approximately the same whether the gland is removed through a suprapubic or a perineal incision. The suprapubic transvesical approach has the advantage that it permits the removal of co-existent lesions of the urinary tract, such as vesical stones and diverticula or even tumors of the bladder. While this is impossible in a one-stage perineal operation, exploration and drainage of the bladder preliminary to perineal prostatectomy, as carried out by Lowsley, overcomes this disadvantage. It has been the experience at the clinic, in most cases, that the presence of vesical stones or diverticula contra-indicates a one-stage operation, since they are usually associated with infection of the urinary tract, which combined with the additional operative procedure increases the risk of prostatectomy. In some instances, however, diverticula may exist with but little cystitis and the absence of infection and of foul urine in the diverticulum may permit, by means of a suprapubic approach to the prostate, the safe excision of the diverticulum at the same time as the prostate is removed. On the other hand, Bugbee has obtained his best results by performing suprapubic prostatectomy in two stages as a routine, treating associated lesions of the bladder and providing drainage at the first operation, and later, when the condition of the patient permits, enucleating the gland after enlarging the suprapubic drainage sinus sufficiently to permit the introduction of the finger into the bladder.

Without preliminary preparation including control of urinary infection and in the absence of studies of renal function to determine the capacity of the kidneys, the risk of a one-stage operation may be lower when the prostate is removed through a perineal incision, on account of the dependent drainage, and because the perivesical tissues have not been opened to infection. When the prostate is small and considerable prostatitis is present, the perineal operation can be expected to give good results. This applies particularly when the obstruction is a result of compression of the prostatic portion of the urethra by adenomata of the lateral lobes. Previous operations on the bladder may cause it to contract to the extent that the perineal approach to the hypertrophied gland becomes preferable. Postoperative ventral hernia complicating such previous operations may indicate a perineal operation which can be thus performed without fear of opening the peritoneal cavity. Recently, it was necessary to perform perineal prostatectomy in a case in which a large postoperative ventral hernia had developed following three previous operations on the bladder elsewhere for the removal of vesical stones.

Should the perineal approach be chosen, the technique of Young has become classic as a model. Davis has devised a hæmostatic bag to be used after perineal prostatectomy, and this has proved as satisfactory in the control of immediate hæmorrhage following perineal prostatectomy as the Hagner-Pilcher bag in the suprapubic operation. Still considerable experience is required for perineal prostatectomy, if uniformly good results, as measured by urinary control and healing without fistula, are to be expected. Occasionally, even after skillfully performed perineal prostatectomy, these unpleasant sequelæ occur and may necessitate secondary operations.

The determination of the patient's condition prior to operation and the restoration of patients handicapped as a result of obstruction of the urinary tract, have assisted greatly in reducing the mortality rate of prostatectomy. Whether the operation is to be performed in one or two stages, suprapubically or perineally, is dependent on the general condition of the patient, the pathological condition of the urinary tract, and the experience of the surgeon, for what in the hands of one is a safe operative procedure with little possibility of postoperative complications, in the hands of another becomes an operation of necessity rather than of choice.

In general, after preliminary preparation for operation, if the condition of the patient is such as to permit safe prostatectomy, it makes little difference, from the standpoint of mortality rate, whether the gland is removed through a suprapubic or a perineal incision.

THE USE OF INSULIN IN SURGERY AND OBSTETRICS

By F. N. G. STARR, C.B.E., M.B., F.A.C.S., F.R.G.S., and A. G. FLETCHER, M.B.(Tor.), Toronto, Canada

THE service rendered to the handicapped surgical patient by the work of that great Canadian, Frederic Banting, can never be measured in words, nor can the gratitude of the diabetic ever be sufficiently expressed.

The diabetic patient is remarkably liable to the development of complications, many of which require surgical treatment. In the past he has been considered a bad surgical risk. As a result of the disordered metabolism the tissues do not heal readily and at the same time lend themselves more easily to infection. Operative procedure and the anæsthetic both aggravate the diabetic state and may convert a mild case into one of coma. With adequate pre-operative and postoperative treatment carried out under insulin administration, these dangers can to a large extent be avoided. It is perhaps still true that from a statistical standpoint the diabetic is a poor surgical risk. A large group of diabetics are well on in years and, besides this, they show premature degenerative changes, especially arteriosclerosis and myocardial disease. Exclude this type of case and it may be said that, under careful control, diabetes does not materially increase operative mortality.

In the preparation of the diabetic patient for operation, various disturbances of metabolism are to be considered: hyperglycæmia, dehydration, ketosis, acidosis, undernutrition, and depletion of the carbohydrate stores. Any of these disturbances may be present to a degree which, if not relieved, may seriously endanger the patient preparing for operation.

The importance of a normal blood sugar level is now generally recognized. It is desirable to allow several days when possible for the determination of the severity of the diabetes and the required amount of insulin to maintain a normal blood sugar level, while the patient is on a suitable diet. In emergency operations, however, this preparation cannot be carried out, but in such cases maximum amounts of insulin should be administered during the time that may be available before operation, for the purpose of reducing the blood sugar level. In this way the liability to postoperative complications will be much reduced, and this is especially true with surgical infections, such as the diabetic carbuncle, in which reduction of blood sugar will lessen the danger of postoperative pyæmia or multiple abscess.

If there has been much glycosuria it is likely that dehydration has taken place. This becomes early manifest in the increasing thirst of the patient, and later by the dry tongue and skin, and finally by the soft eye. It is to be remembered that such a patient may have lost more than 5 per cent of his body weight and that 3 or 4 liters of fluid may well be given for 2 or 3 days, when well marked signs of dehydration are present.

Traces of acetone in the urine as shown by a weakly positive sodium nitroprusside test may be neglected, but any well developed ketone intoxication should be actively treated by increased carbohydrate and insulin administration. Severe degrees of ketosis are unusual unless the case is one of infection, when the insulin requirement may be as much as 50 units every 4 hours, and glucose given in amounts necessary to control hypoglycæmia. As a rule, acidosis will clear up with the ketosis under insulin treatment. When marked, however, alkali may be given, but when this is done the amount of alkali given should be determined and controlled by the carbon dioxide combining power of the blood serum.

The nutrition of the patient and the diet require special consideration. Not only is it inadvisable to attempt desugarization by a course of undernutrition, but *under insulin administration it is possible to prescribe any diet which may be considered necessary to strengthen the debilitated patient.* This is especially the case in preparing for operation patients with chronic cardiovascular disease. In uncomplicated cases it is usual to supply a diet containing ⅔ to 1 gram of protein per kilogram of body weight, and sufficient fat and carbohydrate to provide calories 30 per cent above the basal caloric requirement. Carbohydrate should not be restricted too closely. It is the most readily available form of energy and, besides this, excess carbohydrate appears to be of value in protecting the liver during the course of the anæsthetic and operation. Thirty grams of carbohydrate may be given over and above the usual amount calculated to prevent ketosis. Milder diabetics will tolerate this maintenance diet readily. Many cases, however, will require insulin, which should be administered in amounts adequate to lower the blood sugar level within the normal range. Twenty to 40 grams of glucose or other carbohydrate and 15 units of insulin should be given 2 or 3 hours before the operation.

Postoperative treatment should be carried out to anticipate the disturbances in metabolism as they develop. It is probable that any degree of operative interference aggravates the diabetic state, and further damage to the islets of Langerhans may result. Small doses of insulin, such as 10 units 3 times a day, may be given as a matter of routine, as soon as food is taken. This dosage, however, should be based upon the determination of urinary sugar, and when possible that of the blood. In major operations some degree of hyperglycæmia is unavoidable, but insulin should be increased in an attempt to control the rising blood sugar level. When the patient is able to take food, a suitable diet is provided by milk and cream and, when tolerated, eggs, fish, fowl, meat, vegetables, and fruits gradually added to a maintenance level. Fluids should be provided freely.

After operation ketosis may develop very rapidly and means must be taken to reestablish adequate carbohydrate utilization. When there is hyperglycæmia and glycosuria, increased doses of insulin may be sufficient for this purpose. Otherwise additional carbohydrate must be supplied. Postoperative nausea and vomiting may occur, aggravated by the ketone intoxication, and marked dehydration may set in. It may be necessary, therefore, to administer the glucose and fluid intravenously, giving 500 cubic centimeters of 5 per cent solution as often as may be required. In the event of infection or severe toxæmia the insulin value may be markedly lowered and the patient may require even as much as 50 units or more, 4 times a day. Under such conditions the insulin administration must be pushed until its effect is observed in the lowering of the blood sugar level and the control of the ketone intoxication.

What has been said about the diabetic surgical risk applies with equal force to the pregnant diabetic. The use of insulin has been advocated in the pernicious vomiting of pregnancy. This, however, does not seem to be necessary for, according to a recent study by Harding and Van Wyck, now in press, the ketonuria is the result of dehydration. They come to this conclusion: "Its use in skillful hands may be harmless, but we do not believe it to be a valuable adjuvant to treatment," and "the successful treatment of hyperemesis gravidarum depends upon the use of fluids."

THE PREVENTION OF DISEASE

A Tribute to Dr. Murphy[1]

By Sir W. ARBUTHNOT LANE, Bt., M.S., F.R.C.S., London, England

Introduction by Rudolph Matas, M.D., LL.D.
President of the American College of Surgeons

AVAILING myself of the agreeable privileges that are accorded me by my official position I am happy to extend a hearty welcome in behalf of the College to the eminent representative of British surgery, whose name and fame are known wherever the language of surgery is spoken, Sir Arbuthnot Lane.

Sir Arbuthnot has come from overseas to deliver the Murphy Oration and to join us in annual tribute to the memory of one of our illustrious founders whom the world justly recognizes as one of the most brilliant exponents of American surgery. Apart from his mission and his message, the presence of Sir Arbuthnot in our midst is a signal for an enthusiastic manifestation of pleasure and approval. Sir Arbuthnot's frequent visits to this country, his long known and tried friendship for Americans and American institutions, and his generous and unfailing hospitality and kindness to all American surgeons who have flocked to his clinics at Guy's Hospital, London, suffice at all times to assure him of a cordial reception.

To those of us who have enjoyed the privilege of seeing him at work in his operating theater at Guy's, it would be superfluous to speak in his praise. Those who have not been so fortunate, know his merit in their own work, for it is through his original teachings and example that one of the most fruitful advances in modern surgery has been accomplished.

Many years ago, when the study and teaching of human anatomy was my chief pre-occupation, I learned to admire him, through his published writings as a master of that fundamental branch of surgical knowledge in which the British school has excelled and still remains as a model and an unchanged inheritance in our class rooms. Later, when I came in contact with him, I was not surprised to find a surgeon whose courage and daring were only surpassed by his originality, resourcefulness, and skill. In one day, I saw him do a difficult palatoplasty for cleft palate, a resection of the lower jaw, an open reduction and plating of both bones of the forearm for fracture, and a resection of the colon for what is now known as Lane's disease, upon all of which he stamped the seal of his personality by the originality of his methods and the smoothness, ease, and perfection of technique that proclaimed him a great master—a master who dared where others quailed, and who succeeded where others would have failed without his skill, his precision, and the discipline and method with which he planned his operations.

Sir Arbuthnot Lane is one of those rare surgeons who knows no limit to the anatomical territory in which he can exercise his art. He is as much at home in the extremities as in the head and trunk; in the bones and joints as in extirpating a colon; in doing an ileosigmoidostomy as in ligating and excising an internal jugular to stop an otitic infection on its fatal way to the lungs.

In this extraordinary versatility, we recognize a close analogy to the creative and technical genius of Murphy. In both, the mind in conception of ideas and the hand with the cunning of the craft, are united in harmony to attain great objectives, to open new and untrodden paths. In both, the craft of the artisan is inspired and guided by the imagination of the artist.

Murphy invented that marvel of mechanical ingenuity, the "Murphy button," which gave a new impetus to intestinal and abdominal surgery. But more than this, he later conceived a new pathology of septic peritonitis and by his original methods of treatment robbed this most formidable of surgical complications

[1]The John B. Murphy Oration in Surgery, presented at the Clinical Congress of the American College of Surgeons, Philadelphia, October 26, 1925.

of half its terrors. By his original method of direct end-to-end anastomosis of divided arteries, he laid the foundation for the modern conservative treatment of wounded blood vessels. He gave a new hope to the victims of pulmonary tuberculosis by adding artificial pneumothorax to our therapeutic resources. He illumined our knowledge of nerve repair and injury. Last, but not least, he revolutionized and systematized the principles and practice of joint surgery, thus laying the foundation for the rehabilitation of numberless cripples by his method of modern arthroplasty.

Lane gave us a metallic plate and the mechanical implements which, modified in many ways, have been instrumental in transforming the old methods of bone setting into a finished osteoplastic art. He gave a new outlook on the treatment of fractures and created a veritable renaissance in the history of the traumatology of the skeleton. He taught us new methods by which to overcome many hitherto insuperable difficulties in the cure of cleft palate. He taught us how to save lives that would otherwise have been lost from the migration of acute ear infections by the timely ligation and excision of the jugular vein. He taught us the secrets of a new technique, based upon a mastery of anatomical detail, which made the extirpation of the entire colon a feasible and legitimate operation. He gave us a new view of the mechanism and effects of chronic intestinal stasis and, in doing this, he pointed to hitherto undescribed anatomical anomalies and pathological membranes which retarded the fæcal circulation, now familiar to us as Lane's kinks; but, more than this, he created a new clinical picture of chronic intestinal toxæmia, which is now known as Lane's disease.

Both Murphy and Lane enlarged our vision, by expanding the surgical horizon and leading us to new surgical possessions which we are now industriously cultivating with profit and with promise of still greater benefits. The broad concepts and innovations initiated by both have gone through many vicissitudes and modifications since the time when they were first given to the profession, but, whatever the future may have in store for their ultimate destiny in theory and practice, the names of Murphy and Lane will remain permanently inscribed in history as men who made surgery better than they had found it.

How fortunate and fitting that this hour, which we have reverently consecrated to the memory of an illustrious founder, who gave luster and world renown to American surgery, should be graced by the presence and praise of one who shared with him, in an allied sphere, the glory of the pathfinder and the pioneer! It is a tribute of one master to another master. It is the voice that proclaims the solidarity of our guild; its unity of purpose; its aspirations and endeavors; its labors and its sacrifices; its rejoicings and its rewards in promoting the welfare of mankind.

And this is the soul of surgery and the spirit which animates this College, which we see embodied in John Benjamin Murphy and in the person of our honored friend and guest, Sir Arbuthnot Lane.

THE JOHN B. MURPHY ORATION IN SURGERY

YOU have done me a very great honor in asking me to deliver the Murphy Oration. I need hardly say that I am very proud and pleased to do it, and that I heartily appreciate the compliment the invitation carries with it. I have paid you so many visits and have always been received in such a very cordial and friendly manner, that I am almost tempted to regard myself as one of yourselves. Certainly I am intensely in sympathy with the magnificent efforts you are making to advance our profession from every point of view.

Like you all, I loved that great, big-hearted, generous man, who was so full of enthusiasm and energy. Though seriously handicapped by feeble health he never allowed anything to interfere with the work in which he took so much pride and interest so that he materially shortened his life.

I was very fortunate in making Dr. Murphy's acquaintance many years ago, as I had obtained one of his buttons and had used it successfully 6 months before anyone else in England. The case was published in the *Lancet*

early in 1894. Learning of this, Dr. Murphy, accompanied by his beautiful wife, called to congratulate me on the result I had obtained by the use of his most ingenious and useful device. How many lives that button has saved and how much it has stimulated surgeons to improve their technique is well known to us all. It proved to be one of the greatest advances in abdominal surgery. There are still conditions in which no other method can approach the Murphy button in usefulness. Up to that time the name of Murphy was practically unknown on our side of the water. Our friendship dated from that visit and I have always regarded it as a very great privilege to have since had many opportunities of discussing surgical problems with one with whom I was entirely in sympathy. He was always so ready to take an active interest in any new problem on which his fertile and imaginative brain invariably cast some fresh light. He was essentially an original man, as well as being a superb teacher. I know, as do so many of his intimate friends, how much Murphy owed to the constant care and devotion of his charming helpmate, who seemed to possess the secret of perennial youth. While unable to control his indomitable will in the pursuit of science, she did her umost to provide him with the care and attention necessary to enable him to continue his arduous occupation. Not only did she look after his health but she took a very active share and interest in his surgical work. Although many years have elapsed I can vividly remember her description of the manner in which the button was evolved and the anxiety and interest with which they both watched the result of its use in animals before employing it in the human subject. Her love and care played no small part in making Murphy's career the great success it was.

What struck me most in Murphy was his wonderful generosity, a quality which is so largely shared by other great American surgeons. He was always most anxious to accord praise to others wherever it was possible and often avoided claiming for himself much original investigative work.

The excellence of his surgical work appealed to everyone as did also his remarkable breadth of vision and his foresight.

He possessed in a peculiar degree a power to hold and hypnotize his audience beyond that of any other surgeon I have met. He appeared to take possession of his hearers and to imbue them with a feeling that whatever he said was true.

Few of us will forget his operations and his demonstrations in his theater. Geniuses of the type of Murphy are not teachers in the ordinary sense in that they do not produce the like among their immediate entourage, but on the other hand they exert an immense and widespread influence on the whole community. That was essentially the case with Murphy.

I spent much time with him in that memorable conference in 1914, of which he was the distinguished president and when we had many conversations about chronic intestinal stasis in which he took a very active interest and for which he foretold a great future. At that time not only did few people accept my views on this subject but the bitterness of the attacks of many members of our profession was characteristic of their usual attitude toward any ideas with which they were not familiar. Murphy was infinitely more practical. He saw a large number of my cases both before and after operation, he was present at many operations, and he investigated the histories of these patients in his usual thorough manner. He was one of those who accepted my views and gave me his hearty encouragement for which I was most appreciative and grateful. I am also glad to remember that he took precisely the same attitude when the operative treatment of simple fractures was being opposed in the usual acrimonious manner.

I trust that you will not think me egotistical if I read to you a portion of Dr.Murphy's last letter to me which I need not say gave me very great pleasure. It is characteristic of him.

"My dear Colleague: . . . I have still greater feeling of gratitude to you for your contributions to the Congress in so many ways. Your indefatigable zeal in your clinics made you the ideal busy surgeon of the world. You cannot comprehend how much you have endeared yourself to the American medical profession by your work during the Congress. The doctors are returning now and every day I hear comments on your work. Surely your ears must often burn as they are so sincere in their praise of you. I feel that in doing this work you were paying a personal

compliment to me as president, as well as to the surgical profession of America. Your colleagues certainly did themselves proud, and all who had the opportunity of attending the Congress say that it is the best meeting we have ever had from an educational standpoint."

I feel that I cannot do better than to discuss with you that subject which was nearest his heart when I last saw him, since I am certain that he would have asked me to do so if he were alive and with us here.

I am very glad to do it since I realize that intestinal stasis is the dominant factor in medicine being the basis of all morbid conditions peculiar to a state of civilization, and that the greatest duty that devolves on the members of our profession is by obviating its development to prevent disease, to safeguard the community from the misery, ill-health, and loss of earning capacity it entails, and to raise the physical standard of the people to the highest possible level. If we can succeed in doing this our general happiness and well-being will be enormously increased and the maximum enjoyment of life secured.

It is not that I wish to depreciate the skill and ability of surgeons and physicians who do their utmost to deal with the symptoms and end-results of chronic intestinal stasis, but I am convinced that it is only by following the course indicated, namely by prevention, that stasis and its end-results will cease to exist and the necessity for building an increasing number of hospitals and asylums will disappear simultaneously.

Such was the idea that permeated Murphy's brain and one which I am proud to share with him in endeavoring to carry out in this oration devoted to his great memory such views on *the prevention of disease* as I believe would be acceptable to him if he were present with us.

In order to be able to obviate the incidence of disease it is absolutely necessary that in the first instance we shall clearly understand the factors upon which its development depends. Here nature affords us endless experimental evidence, and supplies us with definite data on which we can base our arguments and formulate our views.

There are still existing large native races who are living under normal conditions in their natural surroundings and are eating precisely the same food they have eaten for many hundreds or thousands of years. They have continued the same habits without any variation.

We can also trace these people through the varying degrees of civilization to which they have been exposed owing to their coming in contact with the white man, eating his food and imitating his habits. We observe that while living their normal life in natural surroundings they lead a very happy existence in the full enjoyment of all the pleasures of life. Their very smile suggests a cheerful disposition and a happy outlook on life generally.

They may not infrequently have circulating through the several tissues of their bodies a great variety of organisms, usually in the form of minute worms.

In the vast majority of cases they suffer very little if any inconvenience from their presence: since they do not interfere materially with their activity or with the satisfaction of their appetites. Occasionally, as in the case of yellow fever, cholera, plague, dysentery, etc., the virulent organisms which are the causes of these diseases may prove fatal very rapidly. While the mortality resulting from these infections is great we must remember that they will be eliminated sooner or later by sanitary methods. These natives suffer from none of the diseases of the gastro-intestinal tract nor from the consequences of such affections as abound in civilized communities, which are exacting a rapidly increasing toll from the lives, health, happiness, and general vigor and physique of the race.

The general physique of these natives is magnificent while all their functions are performed normally and efficiently so that they live healthy, vigorous, happy lives. The negroes afford us excellent experimental evidence of the effect which varying degrees of civilization have upon them, for the reason that they migrate from their normal surroundings and acquire the food and habits of those with whom they become domiciled and whom they are proud to imitate, unfortunately to their serious detriment.

As you trace them up through Central America, through the Southern States, and finally

up to Chicago you find that while they have been freed from the infective conditions to which they were exposed in their native surroundings they have steadily acquired the diseases of the gastro-intestinal tract and the conditions consequent upon them in a degree directly proportional to the state of civilization in which they exist. When the conditions and circumstances in which they live become identical with those of the white man, the incidence of the diseases of civilization is exactly the same in the negro as it is with us.

Can anything be clearer than the evidence afforded by this experiment which can be repeated over and over again in the various portions of the globe?

Let us consider what are the differences in the food and habits which have produced such a disastrous change in the health of the native.

In normal conditions the native baby depends entirely on the mother for its food, since there are no artificial substitutes available. The period of lactation is very prolonged, so much so that the child discards the breast only when he begins to take the normal food of its parents.

In civilization the cessation of the napkin stage is followed by an enforced state of constipation for at least 24 hours, since it is considered by white races that a single action a day is sufficient for health.

The native on the other hand continues the habit of emptying the colon after each meal throughout the whole of his subsequent career, consequently the intestines act naturally in response to the normal stimulus and for that reason undergo no abnormal change in their structure during the individual's lifetime.

In civilization the enforced accumulation of at least 24 hours' contents in the terminal segment of the large bowel results in a tendency to its progressive elongation and distention. Because of the inconvenience such a result would produce, nature endeavors to control and prevent this elongation and dilatation by fixing the bowel by acquired bands or membranes which at first secure and shorten the mesentery and later grip the bowel, fastening it immovably to the floor of the iliac fossa and rotating it on its longitudinal axis. By this the lumen of the bowel is obstructed and material is dammed back in the proximal segments of the colon. The portion of the bowel which is anchored ceases to function normally, and becomes inflamed so that the passage of the intestinal contents through it is progressively impaired. If the patient is fat, hernial protrusions or diverticula may form in the bowel proximal to the obstruction, a condition the causation of which I described in 1883. Finally the chronically inflamed and irritated segments not infrequently develop cancer.

A quarter of a century has elapsed since I described the mode of development of this acquired obstruction, the first and last kink, and called the attention of the profession to what I believe to be *by far the most important evolutionary structure in the human body which has ever been observed and one that is productive of the most disastrous consequences. It is a regular Pandora's box.*

I was led to the discovery and appreciation of the importance of this new development by a study of the changes which the body undergoes when its mechanical relationship to its surroundings is altered from the normal.

I found that the human anatomy bears a simple mechanical relationship to its surroundings and varies definitely and rapidly with any change in that relationship. This I demonstrated in the clearest manner possible in the dissecting room of Guy's Hospital by the examination of the dead bodies of laborers who had been engaged during their lifetime in various arduous occupations. A careful investigation of the changes which their structure underwent in consequence of the special functions performed proved to be so characteristic, so definite, and so precise, that from an examination of the anatomy of these workers, one was able to determine with absolute accuracy the labor history of the individual, or in other words the functions he performed habitually during his lifetime.

The laws which I have formulated as governing these changes are quite simple, and can be readily understood by a study of these labor conditions. They are:

1. The skeleton represents the crystallization of lines of force.

2. Pressure produces definite changes.

Fig. 1. Fracture of lower end of humerus.[1]

Fig. 2. Fracture of lower end of humerus.

3. Strain produces definite changes.

4. When apart from the exercise of pressure or strain it is important from the altered mechanical relationship to man's surroundings that an old mechanism should be modified or an entirely new one developed such a change takes place. The modifications in the structure of the body which arise in obedience to these laws ensue in order to meet the altered mechanical relation of the individual to his surroundings and to economize the expenditure of nerve and muscle energy.

The principles which govern the mechanical relationship of the organism to the gastro-intestinal tract which is inside the body differ in no particular from those that influence its behavior in its mechanical relationship to surrounding objects. *Precisely* the same laws apply in both instances.

The consequences which result from the habitual overloading of the end of the large bowel with at least 24 hours' accumulated contents, a condition which is practically universal in our state of civilization and is recognized as being normal, are met on the part of the organism by an attempt to control the excessive dilatation, distention, and elongation of the portion of the intestine which is affected by that accumulation. The effort to establish this control is usually more or less successful. The degree of success attained varies with the vitality of the individual. The attempt to control these changes results in the formation of acquired, firm, strong bands or membranes simulating peritoneum in appearance, which are practically crystallizations of lines of force. They develop along the lines of strain on the under surface of the mesentery of the iliac colon and gradually secure, contract, and shorten it. Finally they grip the bowel itself, rotate it on its longitudinal axis, and fasten it to the floor of the iliac fossa. The alteration in the functioning of this portion of the intestine which is caused by the formation of these bands and by the mechanical effect they exert upon the mobility of the intestine leads to a corresponding degree of interference with the passage of material through the anchored and obstructed bowel. In civilization the consistency of the contents of this portion of the large bowel is almost always firm and may often be quite hard, a condition which increases still further the resistance which the fæcal matter undergoes in its passage through the anchored and obstructed iliac colon. In respect of this factor I need hardly recall to your mind that cancer of the large intestine is eight times more common in the left half of the abdomen than it is on the right side.

I would remind you of another law which I formulated, namely, that *all the changes that ensue in the body in consequence of the endeavor*

[1] See comment on illustrations at end of article.

Fig. 3. Fracture of lower end of humerus.

on the part of the organism to establish a mechanical relationship to abnormal surroundings at first serve a useful purpose, but later tend to shorten the life of the individual. In no instance is this law so true and so clearly illustrated as it is in the case of what I call the "first and last kink." The effect upon the entire gastro-intestinal tract is in the first instance simply mechanical, and is analogous to that which would result in every house in a town from a block in its main sewer. Later it results in the contamination by septic organisms of the nutrient material dammed back and stagnating in the small intestine and stomach and in the terrible sequence of the innumerable morbid sequelæ which ensue in consequence of these mechanical and toxic conditions. When I first called attention to this kink and its consequences the less observant and more conservative portion of the profession denied their existence and some isolated members with that want of courtesy which is so often associated with a corresponding lack of comprehension boldly asserted that the kinks were not present in the patient's body but existed only in my brain.

Fig. 5. Fracture of lower end of humerus.

Fig. 4. Fracture of lower end of humerus.

The more intelligent section of the medical profession looked for and investigated the several kinks I described and finding them began debating their origin. Some believed that they were produced by inflammation, since they could not conceive of an acquired band or adhesion arising in any other way. Others considered that they were congenital. Many observers while recognizing them were of the opinion that they did not exert any control over the passage of the contents through the anchored bowel. The simple manner in which they come about was not realized for the obvious reason that the very definite changes which the body undergoes when its mechanical relationship to its surroundings is altered from the normal received little or no attention from a profession accustomed to deal only with the end-results of stasis which constitute surgery and medicine.

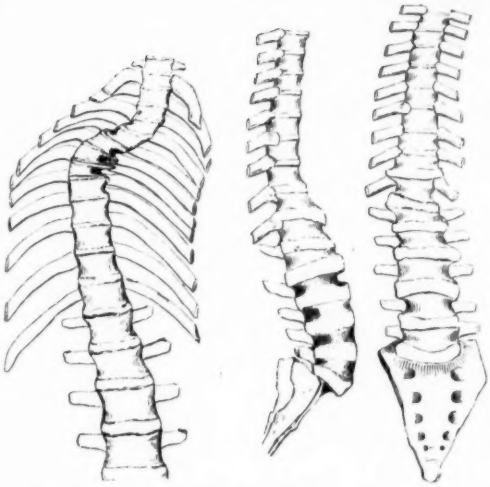

Fig. 6 (left). Spine and ribs of a brewer's drayman.
Figs. 7 and 8. Spine of coal heaver.

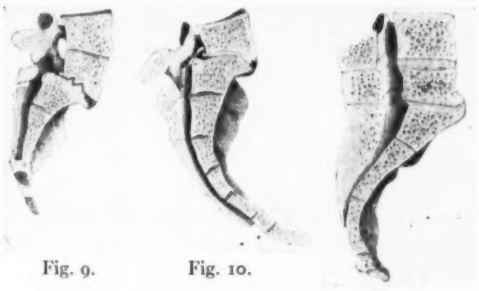

Fig. 9. Fig. 10. Fig. 11.

Fig. 9. Fourth and fifth lumbar vertebræ and sacrum of coal heaver.
Fig. 10. Fifth lumbar vertebra and sacrum of deal porter.
Fig. 11. Fourth and fifth lumbar vertebræ and sacrum of laborer who carried loads in front of him.

While in a considerable proportion of cases the body has sufficient vitality to form these bands and to effect an obstruction limited to this area, in a number of feeble subjects, because of a want of formative capacity, either no bands are developed or they are not sufficiently strong and rigid to secure the colon which escapes from their controlling influence. In consequence the pelvic colon becomes progressively elongated and distended. The puddling in the pelvis of this elongated and dilated distal portion of the colon produces a degree of obstruction to the passage of solid contents through it, which is increased by straining in the effort to expel the motion. It is important to realize that the obstruction so produced is often much greater than that which results from the limited and localized obstruction brought about by the acquired bands forming the first and last kink. The consequences of this type of obstruction in feeble subjects differ from those produced by the kink in that throughout the length of the proximal intestinal tract little or no effort is made to control the elongation and distention of the colon, small intestine, and stomach. Consequently, ulceration and cancer of the large bowel, duodenum, and stomach so common in association with the first and last kink, which are due to a definite local constriction, occur very rarely. It is to this condition that the term enteroptosis has been applied and many surgeons have endeavored to benefit their patients by performing such futile operative procedures as sewing up the several dilated and elongated segments of the proximal bowel, apparently not realizing the causation of the condition. On the other hand in this type, which may for convenience be called the atonic variety, the infection of the food supply which is accumulated in much greater quantity in the elongated dilated bowel and the consequent intestinal autointoxication together with the changes resulting from it form a very much more marked feature. All the mechanical changes I have described have been confirmed radiologically by Dr. Jordan who has studied the subject very closely for many years. They have also been fully verified in every detail by Dr. Nathan Mutch by his accurate, thorough, and complete investigations in the postmortem room of bodies of patients who died of cancer in the wards of Guy's Hospital.

I need hardly remind you of the disastrous sequelæ which result from obstruction of the colon, whether by the formation of bands or by an excessive elongation of its terminal segment. Briefly, they are inflammation of the mucous membrane of the tract, ulceration, first simply septic and often later cancerous, of the several areas which are subjected to constant impact or strain, infection

Fig. 12.

Fig. 13.

Figs. 12 and 13. Spine of laborer who carried loads on his head.

Fig. 14.

Fig. 14. Lumbar vertebræ and sacrum of coal trimmer.

of the intestinal contents, the contamination of the food supply of the body, the flooding of the circulation with organisms, toxins, and other poisonous bodies, and the consequent deterioration of the cells of every tissue in the body, rendering them liable to the invasion of organisms and to the production of innumerable diseases.

Perhaps the term that best describes chronic intestinal stasis is that applied to it by Pauchet. He calls it *the great disease since it is the cause of nearly all the pathology of civilization.* Its manifestations commence in early childhood and end only in death.

It would occupy your time unnecessarily if I were to attempt to describe in detail the enormous mass of disability, physical deterioration, and disease which is the direct result of chronic intestinal stasis, and the many infections which can find a foothold in the human body only because of the depreciation of the vitality of the tissues by auto-intoxication. Indeed it is not an exaggeration to say that we suffer and die through the defects which arise in our drainage scheme.

Fig. 15 (left). Fourth lumbar vertebra of coal trimmer.
Fig. 16. Seventh cervical and first dorsal vertebræ of coal trimmer.

The treatment of chronic intestinal stasis varies with the stage at which it has arrived and with the nature of the complications consequent upon it.

In the vast majority of cases the obstruction which results from the presence of a first and last kink or from an excessively elongated pelvic colon can be met effectually by the use of that excellent lubricant paraffin which has done more to improve the health of the people, to alleviate suffering, and to prevent disease than any other known substance.

The auto-intoxication which arises because of the infection of the stagnating contents of the small intestine can be controlled by the use of kaolin.

By avoiding the use of all meat and fowl, which are liable to decompose in the infected contents, the infection of the blood stream by toxins, etc., is reduced still further.

The inflammation of the mucous membrane of the intestine which is so often present and which increases the already existing obstruction by producing spasms of the muscular coat can be very materially benefited by belladonna.

In the advanced stages of stasis the careful freeing and division of the bands which form the first and last kink, and the accurate covering of any raw surface by peritoneum, restore to the affected bowel and to its mesentery its normal anatomy and function.

Colectomy is called for only in the most advanced cases which are not infrequently complicated with rheumatoidal, tuberculous, or other infection.

Any secondary infection or complication should be sought for and, if found, thoroughly treated.

Nothing can be more satisfactory than the treatment of chronic intestinal stasis, either

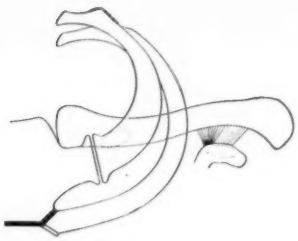

Fig. 19.

Fig. 21.

Fig. 22.

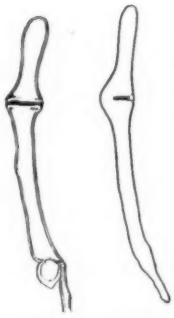

Fig. 17.

Fig. 18.

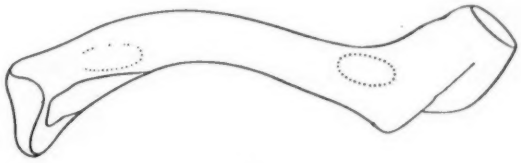

Fig. 20.

Figs. 17 and 18. Showing the changes that take place in the manubriogladiolar joint in consequence of the transmission through it of great pressure. These specimens were obtained from the bodies of laborers who had been engaged in heavy porterage work at the docks. In Figure 17 it is seen that the opposing surfaces of bone have been increased in area considerably, while the intervening ligamentous tissue has been rendered scant and dense. In Figure 18 the joint has been almost completely obliterated by being bridged over in front, and by the formation of masses of bone in the ligament posteriorly.

Fig. 19. Representing the left first and second costal arches, with the manubrium, clavicle, and coracoid process, of a laborer. The manubriogladiolar joint is amphiarthrodial in character, while the joint that has developed in the ossified first costal cartilage is freely arthrodial. The position of the costoclavicular articulation is indicated by the dotted outline on the first arch. On the upper surface of the coracoid process the facet which articulates with the clavicle forming the coracoclavicular joint is similarly indicated.

Fig. 20. Representing the under surface of the clavicle with the articular facets which correspond with those on the costal arch and coracoid process.

Fig. 21. Scapula of shoemaker.

Fig. 22. Scapula of deal porter.

simple or complicated, by careful attention to diet and habit, while in suitable cases operative interference affords results which would seem to be little short of miraculous.

As the result of observations which have now extended over many years, I am exceedingly impressed by what I believe is the invariable sequence of cancer and intestinal stasis. In my opinion there are two factors in the causation of cancer as we see it in civilization, namely, the mechanical and the toxic.

It is not till these factors have produced sufficient degenerative change in the tissues of the body that they become a soil or medium in which the cancer organism can grow. This organism cannot grow in a healthy organ.

I have observed cancer imposed on the mechanical and toxic results of chronic intestinal stasis so invariably that I am convinced that the sequence I have described is true in every particular.

I have been equally impressed by the absence not only of cancer but of all the other direct and indirect results of stasis as we see them in civilization in such communities as do not suffer from chronic intestinal stasis.

Our only hope of preventing cancer is by obviating the development of chronic intes-

Fig. 23 (left). Lower end of right humerus of coal trimmer.
Fig. 24. Upper end of right radius of coal trimmer.

Fig. 25. Right elbow joint of coal trimmer.

tinal stasis and all its manifestations and results. Cancer is only one of the consequences of stasis but it is infinitely the most incurable and fatal.

The prevention of cancer can be brought about only by a complete revolution in our diet and habits. We must eat such food as will obtain for us the same results that exist in primitive man, and we must discard such diet as is deprived of the important components of natural foods. The public must be educated in the knowledge of food and must be impressed by its extreme importance to health.

I am certain that they will be keenly interested in the subject, when they learn the explanation of the very simple causes which bring about so much illness, misery and death, and recognize the far-reaching result of those causes. We must employ every means in our power to distribute information broadcast in the community, by literary efforts, by propaganda in the newspapers, etc. We will thus ensure that a new people will grow up and replace the miserable specimens of humanity which form quite a considerable proportion of the inhabitants of civilized countries especially in the large towns.

Now I come to the important suggestion to which I wish to call your most urgent attention and to ask for all the help you can give in the matter.

It must be perfectly obvious that it is much more desirable and easy to endeavor to prevent the occurrence of cancer than to attempt to deal with it surgically when the condition is established, since we are all familiar with the fact that when first detected it is so frequently already ineradicable. With that end in view

Fig. 26. Fig. 27. Fig. 28.

Fig. 26. Atlas of shoemaker.
Fig. 27. Axis and third cervical vertebra of shoemaker.
Fig. 28. Occipital bone of shoemaker.

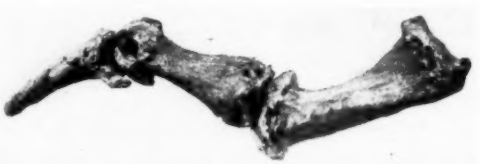

Fig. 28a. Photograph of the bones removed from the right thumb of a shoemaker.

we have established a new society in Great Britain with the object of endeavoring to carry into effect the several principles enunciated in this address. It is called "The New Health Society." It is supported by a large number of the most distinguished lay scientific and medical people in Great Britain who are intensely interested in promoting the health, happiness, and well-being of the people and in the elimination of the ill-health and disease which they believe are avoidable.

What I would ask you to do is to make a similar society in America and to call it "The New Health Society" dedicated to the memory of the great man whose name and fame we are now gathered together to honor and revere. In that way the name of Murphy whose whole life was devoted so unselfishly to helping his fellow creatures will live forever and will stand for all that is great and good in humanity.

In future let the subject of the Murphy Oration be The Prevention of Disease.

Could any man wish for a grander monument or a nobler epitaph!

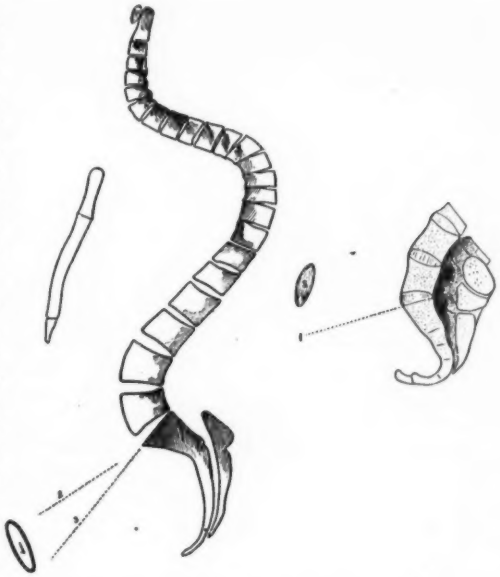

Fig. 29 (left). Spinal column of old woman.
Fig. 30. Lower part of spine of feeble old subject.

COMMENTS ON ILLUSTRATIONS

The illustrations in this article form excellent examples of the results of the specialization of function in laborers and afford indisputable evidence of the truth of the laws which I have formulated.

In order to obtain a thorough insight into chronic intestinal stasis it is necessary to become thoroughly familiar with the manner in which the skeleton and soft parts react when the mechanical relationship of the individual to his surroundings differs from the normal.

Figures 1, 2, 3, 4, and 5 show the manner in which after a fracture of the humerus with displacement of fragments the shaft of the humerus is restored by a process of crystallization along the lines of force, the portion of the old shaft outside the area of the lines of force being completely absorbed.

Figure 6 is the normal spine and portion of the ribs of a brewer's drayman. It represents the attitude which the man assumed on a single occasion fixed and exaggerated. His function was to carry a barrel of beer on his right shoulder.

Figures 7 and 8 show the changes which the spine of the coal heaver undergoes in consequence of his very laborious occupation. The bodies of the vertebræ are altered in form and their margins have been united to one another by bridges of dense ivory-like bone.

Figure 9 represents the sacrum of this laborer in section. Note the destruction of the fibrocartilage, the forward displacement of the last vertebra producing the condition commonly called spondilolisthesis, the division of the arch of the fifth lumbar vertebra into three separate parts and the varying development of the bodies and spinous processes of the lumbar and sacral vertebræ.

Figure 10 shows the somewhat similar changes which take place in the lumbosacral joint of a deal porter, the ankylosed joint of the coal heaver being replaced by a typical arthrodial articulation. This results from this laborer having to lift logs from the ground and to deposit them there. Contrast these variations with those present in a laborer whose occupation entailed his carrying loads in front of his trunk as in Figure 11.

Figure 12 shows some of the changes that develop in a man who carries loads upon his head. Figure 13 shows the upper part of the spine in section. Figures 14, 15, and 16 show portions of the spinal column of a coal trimmer. Figure 15 shows the manner in which the fourth lumbar vertebra has been divided in the very forcible rotation of the trunk which occurs in this occupation. Figure 14 shows the divided vertebra in position with development of a synovial cavity in the fibrocartilage between the fourth and fifth vertebræ. Figure 16 shows the manner in which the head of the first rib is secured by a bony shelf in order to enable the swing of the shovel to be carried out most effectually.

Figures 17 and 18 show the changes which are produced in the manubriogladiolar joints in laborers who carry heavy loads upon the back or shoulder.

Figure 19 shows the manner in which the first costal cartilage reacts to the tremendous strain to which it is exposed. The cartilage becomes converted into bone and an arthrodial joint is developed in it. In the same figure are seen the new joints which form between the clavicle and the first costal arch and the coracoid process. In Figure 20 the situation of these new developments is shown on the under surface of the clavicle.

Figures 21 and 22 represent the scapulæ of an aged shoemaker and of a deal porter. Note the remarkable differences in the shape of these bones in consequence of

the very different strain to which they were exposed in these occupations.

Figures 23, 24, and 25 are the bones forming the elbow of the coaltrimmer. They afford excellent examples of the manner in which an old mechanism can be modified without the exercise of pressure or strain. It is immensely to the advantage of this laborer in the performance of his work that he should not have to control the movements of flexion and extension by muscular exertion. This is effected by the deposit of bone on the floors of the coronoid and olecranon fossæ. In this manner the possible range of movement in this joint is limited to the special requirements of his occupation.

Figures 26, 27, and 28 show the developments that have taken place in the occipitoatloid articulation and adjacent vertebræ of an aged shoemaker. Among other changes there is seen a pillar of bone which has grown up from the lateral mass of the atlas and has formed an articulation with the under surface of the occipital bone. It is clear that this new mechanism has arisen without the action of pressure or strain with the object of minimizing the expenditure of nerve and muscle energy consequent on the jerk of the head when the thread is pulled forcibly and abruptly through the leather.

Figures 29 and 30 show many interesting changes which occur in the skeleton in extreme old age due to the absence of attitudes of extension and abduction, and only to the presence of attitudes of flexion and adduction. The results of pressure and strain are well demonstrated in these instances.

EXPERIMENTAL HYDRONEPHROSIS; ARTERIAL CHANGES IN THE PROGRESSIVE HYDRONEPHROSIS OF RABBITS WITH COMPLETE URETERAL OBSTRUCTION[1]

By FRANK HINMAN, M.D., F.A.C.S., San Francisco, California
AND
DUNCAN M. MORISON, M.D., F.R.C.S. (Edin.), Edinburgh, Scotland

In the mechanism of hydronephrosis arterial changes play a definite part. The degree of importance which they occupy in relation to the other causal factors cannot as yet, however, be fully determined. A previous contribution (1) showed the changes which occurred in the renal circulation as a whole during the development of hydronephrosis. Conclusions were drawn from experimentation on the rabbit, two methods being employed for vascular study—barium sulphate-gelatine and celluloid corrosion. The intention of this article is to illustrate more fully the arterial changes as demonstrated by the latter method, celluloid corrosion, since by its means the altering phases are so graphically portrayed. The effect of surgical alterations in the blood supply upon the development of hydronephrosis has been presented in collaboration with Dr. A. B. Hepler (3).

DETAIL OF EXPERIMENTAL PROCEDURE

Throughout the experimentation rabbits were employed. In one series the left ureter

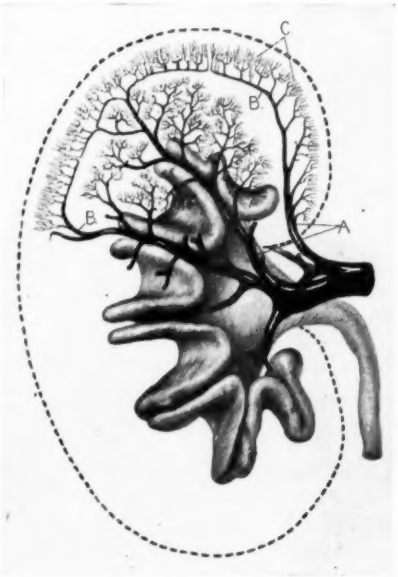

Fig. 1. Diagram based on celluloid corrosion preparations showing the relation of the arterial circulation to the unilobed pelvis in the normal kidney of the rabbit. A, Interlobar arteries—the primary subdivisions of the renal artery. B, Arcuate arteries—the arched continuations of the interlobar trunks. C, Interlobular arteries—which arise from the arcuate vessels, and support the majority of the glomeruli. Since these cortical radicles are the parent stems of glomeruli, their condition and presence or absence may be taken as indicative of function.

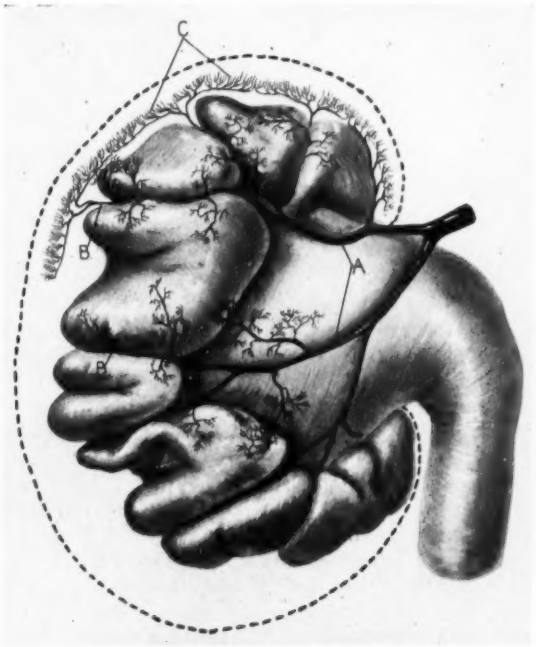

Fig. 2. Diagram based on celluloid corrosion preparations showing the relation of the arterial circulation to the unilobed pelvis in hydronephrosis of 35 days' duration. A, Interlobar arteries. B, Arcuate arteries. C, Interlobular arteries.

[1] From the Department of Urology and the Hooper Foundation of Medical Research, University of California.

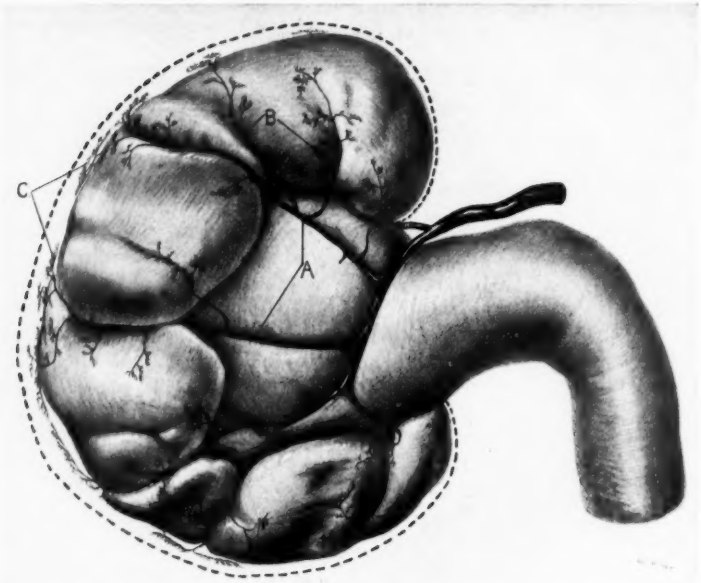

Fig. 3. Diagram based on celluloid corrosion preparations showing the relation of the arterial circulation to the unilobed pelvis in advanced hydronephrosis (about 70 days). A, Interlobar arteries. B, Arcuate arteries. C, Interlobular arteries.
The complete atrophy of all the finer arterial radicles, excepting the few in immediate association with the larger trunks, is here apparent.

was exposed through the lumbar route and divided between ligatures about 2 centimeters below the sinus renalis. In the other series, ligation and division of the left ureter were made above the bladder through a mesial transperitoneal incision.

The hydronephrotic changes produced by the two sites of ureteral ligation were similar except that to a certain extent the higher obstruction favored a more rapid development of the changes.

After total left ureteral obstruction, animals were sacrificed at weekly periods from 7 to 70 days. Two animals were sacrificed at each period; in one an arterial injection alone was made, and in the other the arterial injection was combined with that of both ureters.

Before the actual technique of celluloid injection was commenced, each animal as sacrificed was carefully eviscerated through a midventral incision, the œsophagus above and the rectum below being divided between ligatures, also the cœliac axis and the mesenteric vessels. To allow freer access to the thoracic aorta, the head and forequarters of the animal were resected by cutting circularly through the thorax about its middle. A loose single-knot ligature was then passed around the thoracic aorta about 1 centimeter from its divided end, and another around the abdominal aorta just proximal to its bifurcation. No attempt was made at this juncture to skin the animal.

Prior to celluloid injection, thorough irrigation with warm normal salt solution is made through the aorta until the outflow from the divided inferior vena cava comes clear.

Gentle massage of the kidneys during the irrigation favors more complete removal of the blood.

The ligature, previously applied loosely around the abdominal aorta above its bifurcation, is now tightened. The double injection technique was employed throughout the series, injection being made into the thoracic aorta. The general procedure has already been

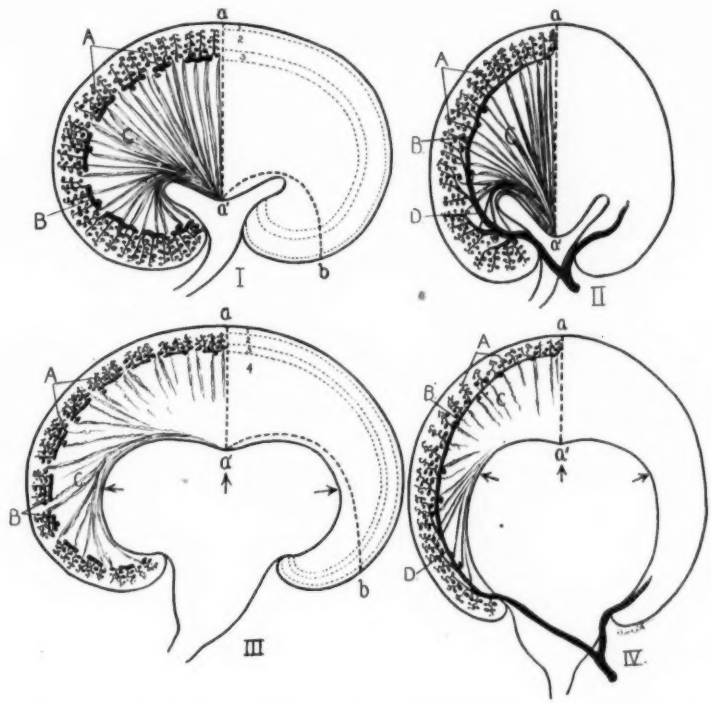

Fig. 4. Diagrammatic sections of kidneys of rabbit showing relationship of the arterial distribution to the zones of the parenchyma, and the cavity of the pelvis. I and III, Longitudinal sections. II and IV, Transverse sections. I and II, Normal relationship. III and IV, Relationships when hydronephrosis has been present about 28 days.

1, Subcapsular zone or cortex corticis. 2, Cortex proper. 3, Cortico-medullary zone. 4, Medulla.

A, Interlobular arteries bearing glomeruli. B, Arcuate arteries. C, Arteriæ rectæ or the straight efferent capillaries of the lowermost glomeruli. D, Interlobar trunks.

In the sections of the normal kidney, I and II, observe the circumferential course pursued by the interlobar and arcuate trunks together with the polar arteriæ rectæ (Ia′–b) in relation to the cavity of the pelvis, and the process of lengthening they all undergo with pelvic distention.

The vessels which pursue a radial course, the interlobular and non-polar arteriæ rectæ (I and II a–a′), show the opposite change, that is, foreshortening and tortuosity (III and IV a–a′).

described (2), and the following details refer more particularly to the application of the method to the present study. A 4 part celloidin solution (4 part celloidin, 100 part acetone), deeply tinted with alkanin, was injected at a pressure of 600 millimeters mercury. After maintaining pressure for 10 minutes a 20 part celloidin solution is substituted and the pressure then kept at 400 to 500 millimeters mercury for fully 12 hours. During the entire process of injection the specimen remains immersed in water.

When it was desired to obtain pelvic and arterial casts, immediately following the arterial injection, the ureters were injected with a 20 part colorless solution of celloidin at a pressure of about 80 millimeters mercury. The hydronephrotic pelvis was first emptied of its contents before the introduction of the injection mass. To obtain a good well-filled

Fig. 5. Normal renal circulation. Celluloid corrosion preparation. Rabbit. Arterial injection made from thoracic aorta. All branches of the abdominal aorta have been resected with the exception of the renal arteries and a few minor lumbar twigs. The abdominal aorta itself has been divided about the level of the inferior mesenteric artery. The specimen shows clearly the relationship of the renal arteries to each other and their manner of individual distribution. L. K., Left kidney.

cast of a large thin-walled hydronephrotic sac is not easy with the celluloid corrosion method. The degree of tension during injection requires careful supervision. A slightly excessive pressure will rapidly produce rupture of the sac and extravasation, whereas the employment of too little pressure will result in imperfect filling and an erroneous conception of the degree of pelvic dilatation.

To ensure complete setting of the celluloid injection mass the specimen should be allowed to remain under water for fully 24 hours, positive pressure being kept up throughout at the points of injection. At the conclusion of this period the specimen is carefully skinned and placed in pure hydrochloric acid. After corrosion in pure hydrochloric acid for 24 to 48 hours the celluloid casts are washed free from the digested tissues by a stream of water. By removing all branches of the abdominal aorta other than the two renal arteries, we could more clearly interpret the specimen.

Since the celluloid corrosion preparations were made by injection through the thoracic aorta the injection mass was necessarily distributed evenly and simultaneously to both renal arteries. Therefore the arterial changes

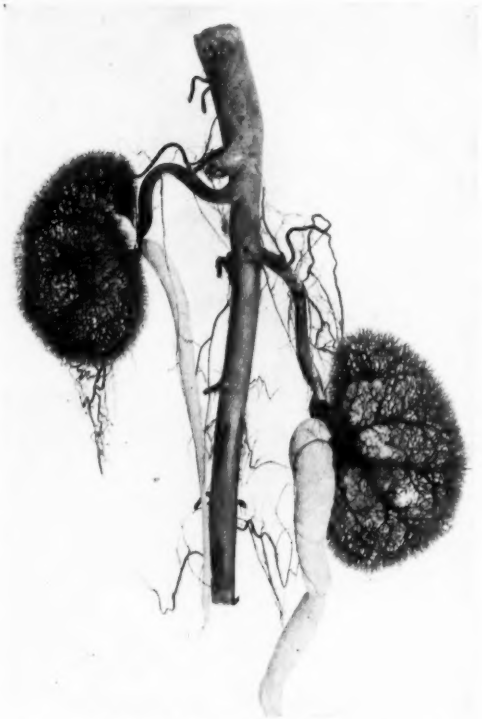

Fig. 6. Hydronephrosis of left kidney, duration 7 days. Celluloid corrosion preparation. Rabbit. Complete arterial and bilateral ureteral injection. Left ureteral obstruction low. On comparison the left kidney shows a dilated ureter with hypertrophy of its accompanying artery; the general arterial distribution presents beginning rarefaction.

presented by the kidney with obstructed ureter may very readily be judged by comparison with the arterial structure of the opposite healthy kidney.

ANATOMICAL CONSIDERATIONS RELATING TO THE RENAL PARENCHYMA

The parenchyma of the kidney presents four zones from without inward: (1) subcapsular zone, or cortex corticis, (2) cortex proper, (3) cortico-medullary zone, (4) medulla. For the purposes of this article the relationship of the arterial distribution to these zones may be taken as follows:

1. The *subcapsular zone* contains only the efferent vessels and capillaries of the most peripheral glomeruli.

R. K. I. L. K. R. K. II. L. K.

Fig. 7. Hydronephrosis, duration 21 days. Celluloid corrosion preparations. Two corresponding interlobar arteries resected in their entirety from an individual preparation; the one from the right kidney (healthy), and the other from the left kidney (obstructed 21 days). The increase in length of the "obstructed" branch is apparent, together with its reduction in caliber, and advancing obliteration of its ultimate interlobular radicles.

I., As viewed from medullary aspect. II., Lateral view. R. K., Interlobar artery from right kidney. L. K., Interlobar artery from left kidney.

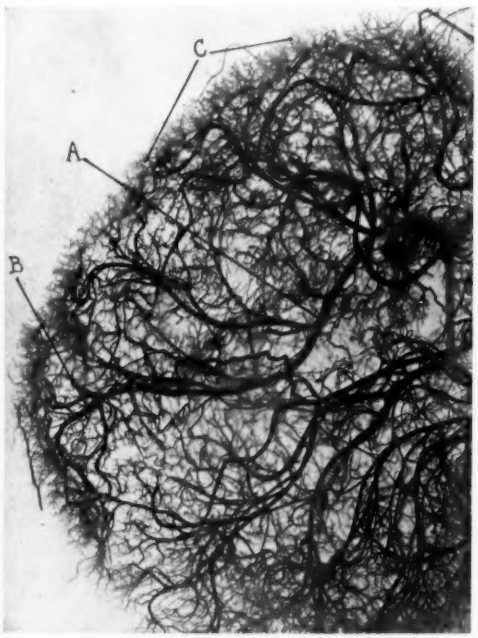

Fig. 8. Hydronephrosis of left kidney, duration 26 days. Enlarged view of outer portion of the kidney to show more clearly the lengthened and attenuated interlobar, A, and arcuate, B, vessels, together with the interlobular branches, C, which are tortuous and foreshortened.

2. The *cortex proper* contains the interlobular arteries which run for the most part parallel to each other and at right angles to the surface of the organ. From these interlobular arteries the vast bulk of glomeruli arise by short afferent branches.

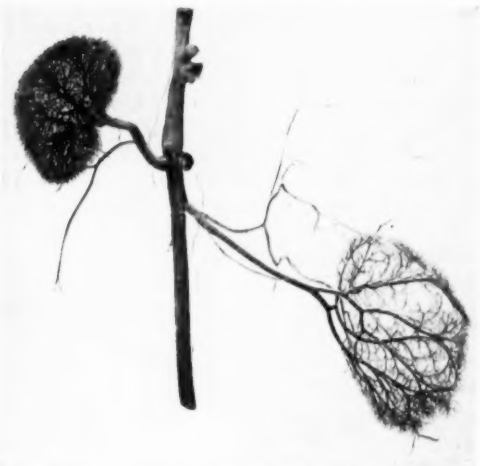

Fig. 9. Hydronephrosis of left kidney, duration 35 days. Arterial injection. The alteration in the finer radicles together with lengthening and thinning of the larger branches of the left renal artery are apparent on comparison with the vasculature of the opposite healthy kidney.

Fig. 10. Hydronephrosis of left kidney, duration 35 days. Combined arterial and pelvic injections were made. In the affected kidney the circulatory changes are shown in their relation to the distended cavity of the pelvis. Two posterior interlobar arteries have been resected in order to reveal the degree of pelvic distention.

Fig. 11. Hydronephrosis of left kidney, duration 56 days. Low ligation of ureter. Combined arterial and bilateral ureteral injections. Note compression of the distended calyx margins of the obstructed pelvis. The finer arterial radicles toward the outer border of the kidney are, even at this period, comparatively numerous though definitely impaired.

3. The *cortico-medullary zone* contains the terminations of the interlobar trunks and their continuations, the arcuate arteries. The origins of the interlobular branches are present in this zone since they arise from the convexities of the arcuate arteries, and the lowermost glomeruli associated with them at this level, together with the glomeruli which take origin directly from the arcuate trunks. The efferent vessels of the glomeruli situated in this zone descend in characteristically straight bundles into the medulla, and are known as the arteriæ rectæ.

4. The *medulla* contains only the straight efferent vessels of the glomeruli of the cortico-medullary zone. These efferent capillaries grouping themselves between the collecting tubules, accompany them to their terminations in the papilla of the medulla.

The changes which each portion of the circulatory tree undergoes during the process of hydronephrotic distention and atrophy are coincident upon the alterations in the various parenchymal zones.

The renal circulation pursues two directions in relation to the cavity of the pelvis, circumferential and radial. The interlobar and arcuate arteries may be said to pass around circumferentially, whereas the interlobular arteries and the fine arteriæ rectæ (excepting those arising from the areas of the two poles) pass radially in relation to the renal pelvis.

THE ARTERIAL CHANGES AS OBSERVED IN THIS EXPERIMENTATION

With complete ureteral obstruction and consequent pelvic distention the renal parenchyma becomes compressed, and then progressively displaced outward by the distending force within. When hydronephrosis is established the two changes which the parenchyma undergoes are coincident. At first, however, compression of the medulla, as evidenced by recession of the papilla, precedes the change

Fig. 12. Hydronephrosis of left kidney, duration 56 days. Posterior view of left kidney resected from preparation in Figure 11. The changes which have occurred at this period in the arterial distribution in relation to the distended pelvis are evident.

Fig. 13. Hydronephrosis of left kidney, duration 49 days. Low ligation of ureter. Combined arterial and bilateral ureteral injections. The changes in the obstructed kidney are evident on comparison. The filling of the pelvis by the injection mass, in this preparation, is somewhat imperfect and accordingly the pelvic cast is smaller than it should be.

of displacement that is characteristic of the later phases.

It is evident that the first portions of the renal circulatory tree to be affected will be those that run radially to and from the cavity of the pelvis, since these are passing in the same axis as the direction of force exerted by the distending pelvis.

With recession of the papilla the medulla becomes foreshortened and consequently the arteriæ rectæ traversing it also become foreshortened. The arteriæ rectæ, however, which pass from either pole run circumferentially to the cavity of the pelvis, and these become stretched and laterally compressed.

With increasing pelvic distention, compression of the parenchymal zones of the cortex corticis and cortex proper lead to rapid obliteration of the former and gradual impairment of the latter from without inward. The contained vessels of the cortex—the interlobular arteries—running radial to the direction of force are affected in the same manner as the non-polar arteriæ rectæ—they become foreshortened and accordingly tortuous, their terminations being less resistant and more removed from the sustaining source of arterial pressure atrophy first.

Coincident with this phase, there begins a gradual radial displacement of the parenchyma with consequent stretching of its constituent zones; it is manifest by a gross increase in size of the organ. An increase in circumference will be more acutely interpreted by structures which pursue a circumferential course; thus the interlobar and arcuate arteries, being subjected to a process of stretching, become elongated. As elastic tubes on stretching lose the diameter of their lumina, these arteries show a similar reduction in caliber. This change is probably responsible for a

Fig. 14. Hydronephrosis of left kidney, duration 70 days. Combined arterial and bilateral ureteral injections. The total size of the obstructed kidney is in this specimen not much larger than that of the opposite healthy kidney, but its vasculature shows marked atrophy.

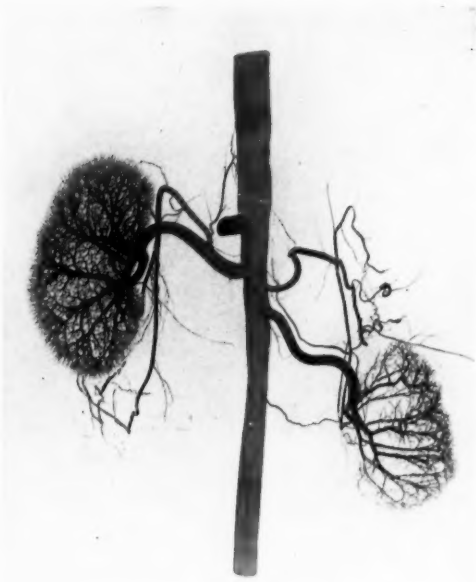

Fig. 15. Hydronephrosis of left kidney, 143 days duration. Arterial injection. The gross size of the obstructed kidney is here relatively small, and is associated with complete atrophy of all the finer arterial radicles (interlobular arteries), excepting in the immediate vicinity of the interlobar and arcuate vessels where a few origins of markedly altered interlobular twigs persist. A comparison between the circulations of the two kidneys is at this advanced period very striking.

diminished blood flow and ischæmia which produces a lowering of tissue tone that hastens the stage of complete parenchymal atrophy.

It is evident that the ultimate ramifications of the arterial tree atrophy first, and that the last to survive are the main trunks and their immediate branches. Atrophy proceeds centralward from the finer radicles where the blood pressure is low, to the larger branches and finally attacks the main trunks the contained pressure of which being high resist complete obliteration.

As glomeruli are indicative of functioning tissue, only those that arise from or are in the immediate proximity of arcuate arteries are capable of resisting for a time the atrophic process. Islands of functioning tissue in organs presenting advanced hydronephrosis are accordingly to be found in the lines of immediate distribution of the main arterial trunks.

Figures 5 to 15 inclusive are direct photographic reproductions of celluloid corrosion preparations. On the analysis of these specimens, together with that of many others, the description in the text is based. Four diagrams are included to facilitate explanation.

SUMMARY

1. The arterial circulation of the rabbit's kidney is distributed in two different planes within the parenchyma in relation to the pelvis of the kidney. The main subdivisions of the renal artery pass around circumferentially, whereas the finer branches are distributed radially to the cavity of the pelvis.

2. With the production of hydronephrosis, the arterial circulation undergoes two phases of alteration. The first phase occurring at the onset is relatively short, and appears for the most part to be a purely mechanical interference. In the second phase, which soon supervenes, there is, in addition to this me-

chanical interference but consequent upon it, a reduction of circulatory function which provides a contributing factor in accelerating the further development of hydronephrosis, until ultimately complete atrophy is attained.

3. With ureteral obstruction, a renal pelvis commences to dilate. This produces progressive compression of the enveloping parenchma. Since the finer arterial branches traverse the parenchyma in a direction radial to the cavity of the pelvis, they are naturally subjected very early to a process of compression in their long axes and consequently become tortuous and foreshortened. This, the first phase, may be regarded as purely mechanical.

4. With continuing obstruction, the renal pelvis assumes larger proportions achieved by definite displacement of the enveloping parenchyma. In this progressive change the gross size of the organ increases, that is, its circumference increases. Consequently all structures pursuing a circumferential course through the parenchyma will be subjected to a process of stretching, or lengthening. Thus the major subdivisions of the renal artery become gradually stretched. Since arteries are elastic tubes, they become with stretching more attenuated and their lumina proportionately diminish. There ensues accordingly a reduced flow of blood through these channels, leading to a state of ischæmia; and this, by lowering tissue tone, favors the progress of atrophy to its ultimate completion.

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THE USE OF DIATHERMY AND OF THE QUARTZ LAMP FOR CONSERVING THE TEMPERATURE OF THE VISCERA AND PROMOTING THE WELFARE OF THE PATIENT BEFORE AND AFTER ABDOMINAL OPERATIONS

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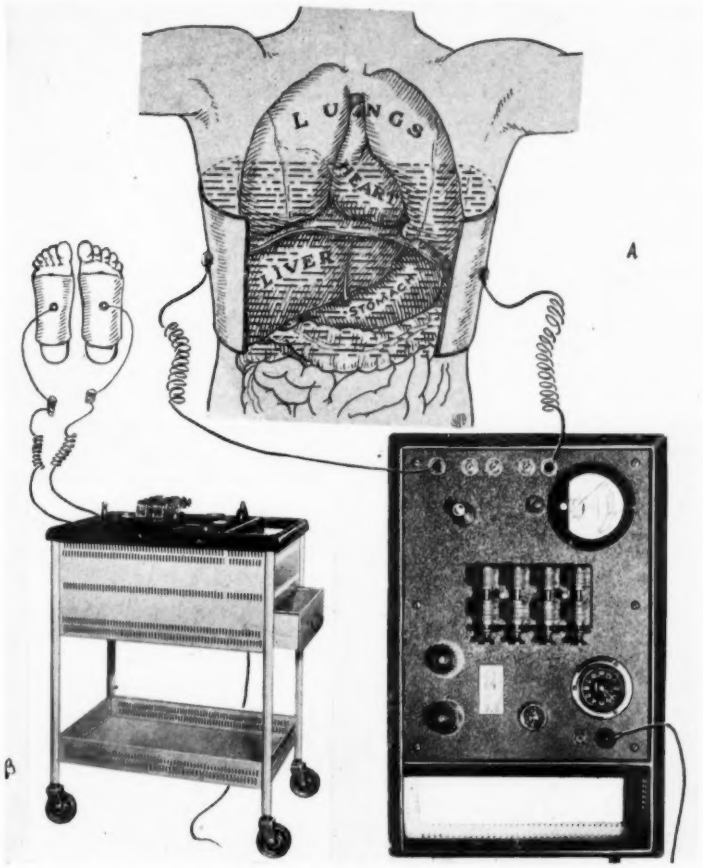
THAT chilling the intestines produces a deleterious, and warming a beneficial, effect has always been known. That exposure of the abdominal viscera of itself alone may produce a fatal result has been frequently observed in the clinic and in the laboratory.

For the patient in shock the application of heat is a primary and most effective method of restoration. Zondek, Taylor, and others have shown that the application of cold over the abdomen is more rapidly effective than the application of heat. According to Zondek: "Our findings confirm those of Chelmonski, Wendrinier and Schutze, Elchel and Schemel, and others who conclude that cold applications to the body surface cause a lowering in temperature of the underlying organs and warm applications affect temperature to a less degree." Taylor found by means of thermocouples that heat penetrates to a greater extent through the abdominal viscera than through skeletal muscle but that in no case was the general body temperature raised by the local applications of heat. Stengel and Hopkins found that the application of ice-bags over the gastric area produced an average drop of from 0.9 to 1 degree Centigrade in 45 minutes while the effect of hot water bottles in the same position for the same period was almost negligible.

These apparently anomalous observations indicate that the function of some vital organ or tissue has been depressed by the lowering of temperature caused by the application of cold, this fact explaining why the application of extensive hot packs is insufficient in some cases to overcome the result of the exposure of the viscera in the course of an abdominal operation.

An attempt to identify the organ, the function of which is depressed by cold and a search for some method whereby the depressing effects of cold upon the viscera might be obviated, resulted in experimental researches which demonstrated that the liver is impaired by any condition which impairs the organism as a whole. In studies of variations in the temperature of various organs and tissues under many different conditions we found that the temperature of the liver together with the temperature of the brain fell progressively when the viscera were exposed, the fall being comparable to that which followed the removal of the liver. These studies appeared to show that cold practically eliminated the essential function of the liver. Moreover, we found that the removal of no other organ except the brain produced so marked an effect upon the organism as the removal of the liver which is followed by the rapid and steadily progressive failure of function of all the organs of the body. This effect is even more marked than that which follows the removal of the brain itself, as, if artificial respiration can be maintained, the rest of the organism can survive for a longer time without the brain than without the liver; after removal of the liver the application of no known method of restoration or of conservation can check the steady decline of the organism to death.

We must conclude therefore that the liver is an organ which performs a major function in the organism, a function which is at least as essential to life as are the functions of the brain, the heart, or the blood. It follows that to the extent to which the liver of a patient is functionally impaired, to that extent is he unable to sustain an operation upon any part of the body, and the surgical risk is increased if the surgical attack of itself further lessens the activity of the liver. In planning the management of surgical operations, there-



Schematic drawing showing application of diathermy to abdominal operations. A. Position of electrodes during operation. B. Portable diathermy apparatus which can be wheeled beside or behind the patient to and from the operating room.

fore, it becomes of prime importance to know how the function of the liver can best be protected. This pertains to any surgical operation, but it is of particular importance in abdominal operations, and of prime importance in operations upon the liver and gall bladder and upon the common duct in particular.

Laboratory researches pointed the way to methods whereby the liver function could be protected against the chilling effects of exposure and its function maintained at or above the normal level during the critical first postoperative hours or days. It is a well known biophysical law that a change of one degree in temperature changes the chemical activity of either a physical or biological system 10 per cent. It follows that when the temperature of the liver is reduced one degree its chemical activity is reduced 10 per cent. Therefore when the exhaustion incident to disease such as cancer of the stomach, for example, has reduced the chemical activity of the liver of a patient to 10 per cent of its normal activity, then if the temperature of the liver is reduced but one degree when the abdomen is opened, death will follow inevitably.

In the course of our temperature measurements, we found that when the abdomen was opened, even if the liver itself was not directly exposed, its temperature fell from 1½ to 3 degrees or more and the impairment of the organism as a whole as a result of this lowered liver temperature was indicated by the fact that the temperature of the brain also fell from 1 to 3 degrees. This progressive fall in the temperature of the brain in these cases was identical with that which followed the removal of the liver. Moreover, in animals under ether anæsthesia a similar lowering of the temperature of both the liver and the brain was observed. Under nitrous oxide anæsthesia on the other hand the temperature of the brain and of the liver was but little altered. A lowered blood pressure induced by hæmorrhage also lowered the temperature of the brain and of the liver. That the organism as a whole cannot function in the absence of the liver function also was demonstrated by the lack of response of the brain to the injection of adrenalin after the liver had been removed. That is, normally the brain responded to the injection of adrenalin by an immediate increase in temperature of from 0.5 to 1 degree; but after the removal of the liver, the injection of adrenalin produced but little or no change in the temperature of the brain. In view of these findings one can well understand why the mere exposure of the abdominal viscera may cause death in a very sick patient even if no operation has been performed and no general anæsthetic has been administered.

We can understand also why the addition of the general anæsthetic and of the operative procedure to the exposure of the intestines may cause the death of the patient who may not be so desperately ill.

This fatal sequence of events was illustrated on a large scale during the War by the effects of abdominal operations performed during the winter months in the front line hospitals, where but few soldiers survived an abdominal operation especially when the operation required a wide exposure of the abdominal viscera. It apparently made no difference how skillfully the operation was performed.

Another remarkable fact established by our laboratory research was that the introduction or application of heat within the abdomen which in most of our experiments was accomplished by the introduction of hot water into the stomach, produced not only an immediate rise in the temperature of the liver but also a rise in the temperature of the brain; and of special significance was the observation that the rise in the temperature of the brain occurred one minute or even more before the increase in the temperature of the liver was noted.

It would appear, therefore, that the application of heat to the liver by conserving the function of that organ should counteract the effect of the exposure of the viscera in an abdominal operation upon any patient, and in particular in operations on the liver or on the bile ducts.

As stated above, in the past, attempts have been made to meet this requirement by hot water pads, hot tapes, the use of the hot water mattress, and a superheated operating room, but none of these methods has satisfactorily met this crucial need.

Recently it occurred to me that the application of diathermy would be an ideal method for holding the temperature of the liver at or above the normal level. The principle of diathermy is that the passage through the tissues of a current from a specially devised apparatus heats the tissues. Therefore, it occurred to me that if one pole of the diathermy apparatus were placed upon the lower chest on one side and the other brought opposite the dome of the liver, then the current would pass through the upper abdominal organs including the liver; and since this current would be continuously applied during the operation the temperature of the liver and of the abdominal viscera in the track of the electric current would be maintained at or above the normal regardless of the exposure of the intestines. It must be borne in mind that on account of the enormous spread of the capillaries, veins, and arteries very near the surface of the viscera, the blood in the whole splanchnic area almost immediately assumes the temperature of the air to which it is exposed. It is almost as if the blood in one part of the circulation were spread out in a thin layer on a great table and were then

collected and again placed in circulation. By the passing of the diathermy current through the liver and the neighboring viscera this thin layer of blood would as it were be made to pass over a hot table, so that warm blood would pass into the rest of the circulation.

In accordance with this conception we have been applying the diathermy current in certain bad risk cases. We have found that the electrodes can be put in place and the diathermy current established before the abdominal incision is made and that neither the surgeon nor the patient need be aware that such a current is passing.

We have found by actual observation that by this means the temperature of the dome of the liver can be maintained above normal throughout an operation in which the abdominal viscera are widely exposed.

The higher incidence of pneumonia after abdominal operations than after operations of an equal magnitude on other portions of the body is well recognized. In view of this fact, and in view of the facts which we have cited one might well question whether this is not the result of the cooling of the blood in the important organs within the chest plus the general depressed function of the organism as a whole as the result of the cooling of the liver. We are therefore now noting whether or not the maintenance of a constant temperature in the liver and other abdominal viscera by the use of diathermy is lessening the incidence of postoperative pneumonia.

We are also using repeated doses of diathermy after operations in feeble and aged patients, and after especially wide and prolonged exposure of the upper abdomen, delivering the dose through the bases of the lungs, as this is the area where postoperative pneumonia is initiated. In addition to the advantage of heat, the increased temperature must induce a more active circulation in this area and thus increase the defense against infection.

Instead of delivering the dose directly through the bases of the lungs, an effective method of maintaining the temperature of the whole organism and accordingly promoting circulation and general metabolism is secured by the passage of the diathermy current through the whole body by applying the terminals to the feet. The diathermy apparatus is so arranged that the terminals can be applied before the patient leaves the operating room, the apparatus being wheeled beside or behind the surgical carriage to the patient's room where it remains as long as this treatment is indicated.

Comparable to the effect of the direct application of heat by the passage of an electric current through the resistant tissues is the application of radiant heat energy by means of the Alpine or quartz mercury lamp. Just as this has been found effective in cases of lowered resistance, of tuberculosis, and so forth, we have found that it is equally effective when applied to anæmic and cachectic patients whose general resistance has been lowered by prolonged wasting diseases.

By the application of these two physical methods which have long been used by the physiotherapist in certain conditions, the surgeon has increased his armamentarium for the effective treatment of bad risk patients, especially for the bad risk abdominal case.

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MUSCLE AND FASCIA SUTURE WITH RELATION TO HERNIA REPAIR

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BECAUSE of the frequency of the occurrence and also the comparative frequency of recurrence, inguinal hernia is ever a live and interesting subject. The percentage of recurrences given by various surgeons, who have followed up their cases and compiled statistics, varies widely. This difference is probably not so much due to a variation of operative procedure among surgeons, or to a lack of skill, as to faulty follow-up methods and varied statistical procedures. Whatever the real percentage of recurrence is, and this is difficult to determine, it is conceded by many to be disconcertingly high.

This admittedly high percentage of recurrence has led to many modifications of the original operations of Halsted (1889) and of Bassini (1890) for the radical cure of inguinal hernia.

In all operations for inguinal hernia one of the principal factors considered requisite for a cure is the effectual repair of the defective abdominal wall. In this repair our chief reliance for many years has been the suture of the internal oblique muscle and conjoined tendon to Poupart's ligament.

Is our reliance in this method of repair justified? Some operators (Coley and others) declare that in their operation for recurrent inguinal hernia they invariably find the internal oblique muscle firmly united to Poupart's ligament. On the other hand it is claimed by Seelig and others that in their operations for recurrent hernia, Poupart's ligament is generally found smooth and glistening and entirely free from muscle attachments.

That this subject is a matter of importance in the cure of inguinal hernia goes without saying. Marchand, in his classic work on wound healing, fails to mention the union of muscle and fascia, although he mentions almost every other conceivable condition of wound healing. Realizing the importance of the subject, Seelig and Chouke recently conducted a series of experimental studies on animals, with a view to settling the question of the union of muscle and fascia. They used dogs and sutured a reduplication of the fascia lata, without tension, to the underlying muscle. In their interesting and copiously illustrated article they conclude that "normal muscle will not unite firmly with fascia or ligament. It is, therefore, a useless procedure to suture the abdominal muscle to Poupart's ligament, in the hope of buttressing a weak or ruptured abdominal wall." As fascia unites well with fascia, they further conclude that the only logical course to pursue is to utilize some type of operation which depends upon fascia to fascia approximation for the repair of the defect.

The matter is of so much importance, and the results and conclusions of Seelig and Chouke so revolutionary, that it was felt that more experiments should be attempted in an effort to throw additional light on the subject. To this end we have performed 37 operations on dogs, suturing muscle to fascia in several ways.

Most of the operations performed were ordinary hernia operations (except that there was no sac to tie off) the central feature of which was the suture of the internal oblique muscle to Poupart's ligament. The normal relation of these parts in the dog are shown in Figures 1 and 2. It will be seen that the angle formed by the internal oblique muscle and Poupart's ligament is greater in the dog than the angle formed by these structures in man. Therefore more tension is required on sutures which draw these parts into apposition in the dog than in man. Both catgut and silk suture material was used, and mattress and interrupted sutures, in different cases. The animals were sacrificed at intervals varying from 1 week to 9 months from the date of operation.

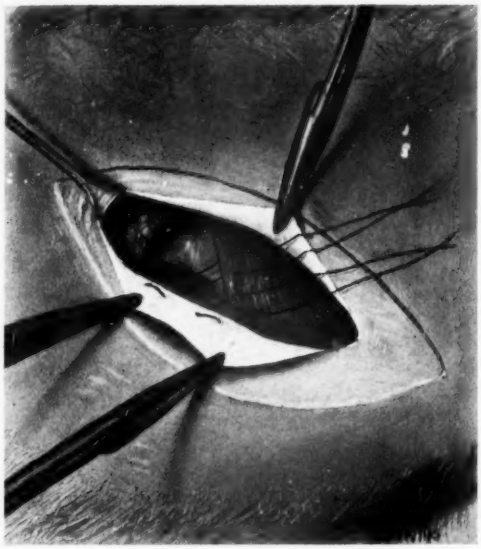

Fig. 1. The fascia of the external oblique is shown split and held back by Halsted clamps, revealing below the normal relationship of the internal oblique muscle and Poupart's ligament in the dog. Mattress sutures are in place ready to be tied.

Fig. 2. Both inguinal canals are here laid open. The left side shows the Normal relationship of the structures as in Figure 1. On the right side, the internal oblique muscle had been sutured to Poupart's ligament with 3 mattress sutures of No. 1 chromic catgut 2 months previously. The resulting union is clearly shown.

In these operations, as a rule, 3 mattress sutures of silk or catgut were used to suture the internal oblique muscle to Poupart's ligament. The various structures of the region were first separated from each other by blunt dissection with the handle of a knife or a piece of gauze, but were not traumatized any more than in the ordinary hernia operation in man. The conjoined tendon did not furnish the firm anchorage for the lower sutures that it does in man, as this structure is of negligible importance in the dog. The fascia of the external oblique was sutured in some cases by a simple continuous stitch, in other cases it was closed by overlapping the edges, and careful suture by interrupted stitches. However, it was shown when the animals were sacrificed that the method employed for the suture of the fascia of the external oblique had no effect on the union obtained between the internal oblique muscle and Poupart's ligament. Examples of the type of union obtained between these last named structures are shown in Figures 2, 3, 4, and 5. It will be seen that there are definite bands of connective tissue uniting the ligament with the muscle, and that in some places the pull of these bands is strong enough to draw bundles of muscle fibers away from their fellows and cause a bowing forward toward the ligament. The union of these structures was of so firm a nature that they could not be pulled apart without tearing the muscle.

Microscopic sections reveal the nature of this process of union between muscle and fascia. The union is the result of the interlacing and growing together of connective tissue fibers from Poupart's ligament and of similar fibers from the epimysium, perimysium, and endomysium of the muscle. We have in effect, then, here a fascia to fascia union. The nature of this union is clearly shown in Figures 6, 7, and 8.

In one dog the iliac artery was injected with India ink before the structures were removed for microscopic section. On studying sections from this material under the microscope, capillaries could be seen passing freely from the muscle coverings into Poupart's ligament. Further proof of the newly established continuity of these structures was thus established.

It is to be expected that Union such as that just described will take place very soon after

Fig. 3. Union between the internal oblique muscle and Poupart's ligament 2½ months after operation. Three mattress sutures of No. 1 chromic catgut were used in making the sutures.

the parts concerned are brought into apposition. That this is true was shown by an experiment in which a dog was sacrificed just one week after operation and good healing was found to be in progress.

It is well known that in the repair of muscle wounds the muscle fibers themselves play

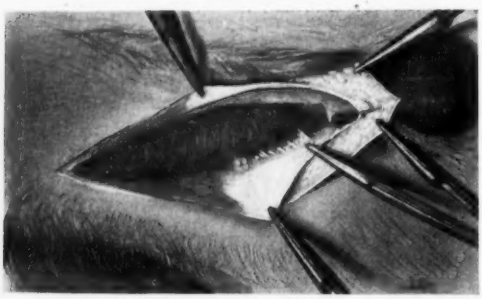

Fig. 5. Union of the internal oblique muscle and Poupart's ligament 2 months after operation. Note the downward bowing of the lower muscle bundles due to the pull of fibrous adhesions. Suture was accomplished by means of three mattress sutures of fine black silk doubled.

Fig. 4. Union of the internal oblique muscle and Poupart's ligament, 1½ months after operation. Three mattress sutures of fine black silk doubled were used in making the suture.

little or no part, but the repair is effected by the connective tissue stroma which forms a firm scar. This scar is inseparable from the muscle, being held in close and firm contact by the innumerable ramifications of the connective tissue stroma among the muscle fibers. With this in mind, in three of our experiments, before suturing the internal oblique muscle to Poupart's ligament, we cut away a narrow strip of the surface of the muscle to be placed in apposition to the ligament, and then sutured the raw surface to the ligament. The amount of fibrous union and scar tissue formation resulting in these cases was greater than in the others. This is what one would naturally expect, as fibers of the ligament and the various fibrous components of the muscle are thus brought into more active contact, and the fibers of the ligament incorporated in the scar with which the injured muscle is healed.

If, then, as these experiments clearly show, union does take place between muscle and fascia, how are the negative results of such reliable workers as Seelig and Chouke to be accounted for? Their work was carried out on the dog, the fascia lata being sutured to the underlying muscle. Their method was as follows: "By a 3 inch (7.5 centimeter) longitudinal incision at the anterior and upper portion of the outer aspect of the thigh, the fascia lata was exposed and incised longitudinally for about 2 inches (5 centimeters). A free edge of the fascia was then folded back on itself, in imitation of the

Fig. 6. Union of muscle and fascia. Transverse section through area of union shown in Figure 5, enlarged 25 diameters. Van Gieson's connective tissue stain.

reflection of the external oblique fascia to form Poupart's ligament. The reduplicated edge of fascia was then sutured to the underlying muscle. This suture of muscle to fascia was always carried out, so that there was no tension whatsoever on the sutures, in order to obviate all possibility of the separation of fascia from muscle by pull." When the animals in which this operation was performed were sacrificed, it was found that "the fascia was widely separated from the muscle to which it previously had been sutured. A very thin and translucent membrane of areolar tissue bridged the gap between the edges of the fascia and the muscle."

On attempting to repeat the operation of Seelig and Chouke it was found that normally there is an intervening layer of areolar tissue between the fascia lata and the underlying muscle, and the thought at once occurred to us that this was probably the reason for the nonunion of the two sutured structures. We therefore operated on both thighs of 4 dogs. On the right side of each we repeated the operation of Seelig and Chouke. On the left side of each we performed the same operation, except that we first removed the intervening layer of areolar tissue, and then sutured the fascia lata to the underlying muscle. On sacrificing these dogs the result on the right

Fig. 7. A small portion of the transverse section shown in Figure 6, enlarged X 80, showing details of the union of the fibrous components of the muscle with Poupart's ligament.

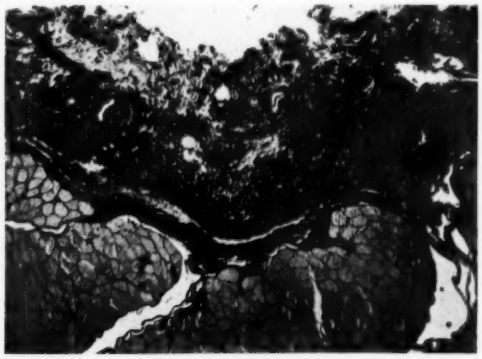

Fig. 8. Union of muscle and fascia. Photomicrograph of section through internal oblique muscle and Poupart's ligament, 3 months after operation. Fine black silk doubled used as suture material. Van Gieson's stain. 60 X.

Fig. 9. Animal sacrificed 2½ months after suture of fascia lata to underlying muscle by method of Seelig and Chouke. Silk sutures still in place but structures are united by only a delicate membrane of areolar tissue.

Fig. 10. Animal sacrificed 5½ months after suture of fascia lata to underlying muscle, the intervening layer of areolar tissue being first removed. Firm union of the sutured structures.

side was found to be exactly the same as that described by Seelig and Chouke (Fig. 9). However, on the left side the fascia lata was found to be firmly adherent to the muscle (Fig. 10), and microscopic sections showed the union to be of the same type as that described above.

A discussion of this subject should not be concluded without referring to the recent experimental work of Gallie and Le Mesurier. In a series of elaborate experiments which formed the basis for their use of "living sutures" in hernia repair, these authors found that fascia readily unites with fascia, the strength of the union depending upon the area of the surfaces in contact, and state that "it was found that the surfaces placed in contact must be completely deprived of their sheath of areolar tissue, otherwise the strength of the union will be very slight. Such surfaces should be thoroughly scraped and scarified in order that when healing does occur the new connective tissue may have a deep grip among the fibers. The importance of these observations is well demonstrated by the uniformity of the success which attends step-tenotomies, and by the frequency of the failures which result from attempts to make side-to-side sutures of severed tendons. They indicate that in all operations in which it is intended to unite any of the fibrous tissues, these tissues must be placed in actual contact with each other over a sufficient distance to make certain that the connective tissue, which forms in the line of union, will be sufficiently strong to withstand the anticipated strain. This means that, in the case of aponeurosis and deep fascia, the edges should be overlapped, and in the case of the tendons, when tenotomy is performed, some form of step-operation should be employed." They further conclude that "fibrous tissues heal to whatever structures they are placed in contact with by ordinary scar. The strength of this scar depends on the degree to which the surfaces which are in contact are denuded of areolar tissue and scarified, and on the area of these surfaces."

Our own experimental results are in entire accord with these conclusions.

SUMMARY

1. The internal oblique muscle and Poupart's ligament unite firmly in the dog when these two structures are brought into apposition by suture. This is in spite of considerable tension on the sutures.

2. The cutting away of a small strip of the edge of the internal oblique, and thus making a raw surface, tends to make the union firmer than usual.

3. When the fascia lata of the dog is sutured to the underlying muscle, these structures unite firmly, provided the intervening layer of areolar tissue has been removed.

4. Microscopic sections show that this union of muscle to fascia is accomplished by the growing together of the connective tissue fibers of the plane sheet of fascia (Poupart's ligament or fascia lata) with the fibers of the epimysium, perimysium, and endomysium.

CONCLUSIONS

These experiments show that muscle unites with fascia by the union of the fascia with the fibrous components of the muscle. The strength of this union depends upon intimacy of contact of the fascia with the fibrous components of the muscle. It is necessary, therefore, that both muscle and fascia be stripped of areolar tissue before they are sutured together. Still better results are obtained if raw surface of muscle is sutured to fascia.

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NECROSIS OF THE CORPUS LUTEUM OF PREGNANCY

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As the pathological findings in two very similar cases of pernicious vomiting of pregnancy were of such unusual nature, the writers are prompted to record their observations. Brief case records are submitted.

The three well known indexes to the medical literature have been consulted regarding necrosis of the corpus luteum, but nowhere have we found a reference to this subject. We also examined several of the more important papers concerning hyperemesis gravidarum and the pathology of the corpus luteum, but were unable to find anything regarding necrosis of the corpus luteum. No doubt this lesion has been studied by others and probably described, but the references are not accessible. Apparently then, we are dealing with an uncommon lesion of some academic importance.

CASE REPORTS

Case 1. Mrs. Aurelia G., a white woman, 27 years of age, was admitted to the Elizabeth Steel Magee Hospital, April 22, 1924, on the obstetrical service of Dr. H. A. Miller, and died April 24, 1924.

The complaint was persistent vomiting.

The past history was essentially negative, aside from the usual childhood diseases. The menstrual periods began at thirteen years, and recurred regularly every 28 days, lasting 4 to 5 days. The onset of the last period, which was apparently normal, was February 8, 1924. The patient had been married 5 years, but had not previously been pregnant.

The present illness apparently began on March 10 and was characterized by slight uterine bleeding lasting 2 to 3 hours. Soon after the bleeding, she noticed nausea while preparing meals. Four days later there was again slight uterine bleeding for 2 to 3 hours, accompanied by cramps. In the meantime she began to vomit. By March 25, nausea accompanied by vomiting had become very severe, and 2 days later she called the family physician. The patient was put to bed and given alkali and a "starchy diet." The vomiting grew rapidly worse, until food by mouth was discontinued and nutrient enemas of glucose with soda were substituted. Still the vomiting persisted and the patient shortly became prostrated. The pulse rate reached 130 per minute on April 21, while previous to this time it had been 90-100 per minute. In addition, glucose solution was given under the breasts and chloral hydrate and bromides were used in the enemas, but the patient remained unimproved. She was admitted to the hospital in a very serious condition.

The physical examination was limited to the pelvis because of the critical condition of the patient. The uterus was found to be the size of a grape fruit, free and movable, quite typical of an early pregnancy. The adnexa were normal. The cervix was posterior and soft. Blood was found on the examining fingers and there was evidence about the genitalia of previous bleeding.

Course in hospital. Because of the uncontrollable vomiting, food and water were not given by mouth. Shortly after admission glucose solution was given intravenously, 500 cubic centimeters of a 25 per cent solution, together with 25 units of insulin subcutaneously. The urine reacted for sugar, acetone, and diacetic acid. The blood contained 200 milligrams of sugar and 23.7 milligrams of non-protein nitrogen per 100 cubic centimeters.

On April 23 the patient appeared slightly improved and craved food and water, but again she was given glucose and insulin as on the day before. The blood sugar was 142 milligrams per 100 cubic centimeters and the urine contained albumin but no sugar.

By April 24 the patient appeared to be somewhat improved and food and water were permitted by mouth. There was slight uterine bleeding, but no cramps. Suddenly the patient became cyanotic and the pulse became very rapid as did also the respirations. The patient died 30 minutes later. On the morning of April 24 the blood contained 166 milligrams of sugar per 100 cubic centimeters. Sugar was present in the urine, but albumin was absent.

The temperature was irregular and varied from 98 degrees to 100.3 degrees F. The pulse rate was generally rapid and irregular throughout and varied from 70 to 170 per minute, the latter rate being terminal.

The clinical diagnosis was hyperemesis gravidarum, together with hyperglycæmia, glycosuria, acidosis, slight albuminuria, and uterine bleeding.

Autopsy (by M. C.) was performed 2½ hours after death. The body was that of a well developed white woman; it was perhaps slightly œdematous. The great omentum was adherent at numerous points to the parietal peritoneum. The stomach and small intestines were markedly dilated, but the intestines and the appendix were otherwise negative *in situ*. The liver was lying free and well above the costal margin. The moderately enlarged uterus was lying free in the pelvis and extended 2 to 3 centimeters, above the symphysis pubis. It was soft, boggy, very vascular and obviously gravid. The broad ligament veins were greatly dilated. The other pelvic and abdominal viscera were negative. No

Fig. 1. Low power photomicrograph of corpus luteum of Case 1 showing widespread coagulative necrosis. Practically all the lutein cells are necrotic.

Fig. 2. High power photomicrograph from the center of the upper half of Figure 1, showing a moderate leucocytic infiltration among the necrotic lutein cells.

evidence of peritonitis was found and there was no excess of peritoneal fluid.

Both lungs were found lying free, greatly distended and apparently very œdematous. The thoracic viscera were otherwise negative in place.

The heart weighed 190 grams, was contracted, and normal externally. The valves and chambers were negative. The aorta, aside from a few fatty streaks, was negative.

The right lung weighed 450 grams, the left 345. The large bronchi and the cut surfaces of lungs exuded much blood-tinged frothy fluid. The lungs otherwise were negative, aside from dependent congestion.

The liver and gall bladder weighed 1,060 grams. The liver was small, smooth, and pale in color with a few whitish capsular scars on the inferior surfaces. On section the color was slightly yellowish and homogenous throughout. The consistency was normal. No scarring of the parenchyma nor passive congestion was observed.

The gall bladder presented nothing abnormal and bile ducts were essentially negative.

The right kidney weighed 125 grams, the left 125. These organs were smooth and slightly congested. The cortex of each was swollen and dull. The pelvic structures of each kidney were negative.

The uterus presented the typical appearance of an early normal pregnancy. It was moderately enlarged, symmetrical, soft, red, and smooth. It measured 13 centimeters from cervix to fundus, 9 centimeters between the cornua and 6 centimeters in thickness. On the posterior surfaces there were three small subserous myomata. The cervix presented nothing abnormal and the canal was tiny.

On section of the uterus, the small fetus, umbilical cord, placenta, and membranes were found intact and the appearance was normal in every respect. The amniotic fluid was clear. The endometrium and myometrium presented nothing remarkable. The fetus measured 6 centimeters crown-heel length.

The ovaries were normal in size and shape and presented nothing pathological. The corpus luteum of pregnancy was found in the left ovary which measured 17 by 12 millimeters on the cut surface. It was yellow in color and presented no recognizable gross changes.

The uterine tubes were congested, but otherwise negative.

The vagina was negative.

The upper small bowel was considerably distended but smooth and glistening. The lymph follicles and lymphoid patches of the ileum were prominent, appearing as whitish gray, slightly elevated, firm structures. The appendix and the large bowel were negative.

The stomach aside from marked dilatation was negative.

The other organs, namely, the spleen, pancreas, urinary bladder, suprarenal capsules, breasts, and also the lymph nodes revealed nothing of especial importance grossly or microscopically. The central nervous system was not examined.

Culture of the heart's blood showed no growth.

Microscopic examination. The material was fixed in Zenker's fluid and stained with hæmatoxylin and eosin.

Sections of the corpus luteum in the left ovary revealed extensive necrosis. The necrosis was irregular in distribution, but involved at least half or more

of the lutein cells. In certain fields practically all the lutein cells between the strands of the supporting connective tissue were dead. The cells were diffusely and deeply stained with eosin and nuclei were not seen. The cell outlines of large groups of cells were fairly well preserved, while the cytoplasm of some was granular and many cells were fragmented, and certain others were undergoing liquefaction. The necrosis had the appearance of a coagulative necrosis. Scattered among the necrotic cells were many neutrophilic polymorphonuclear leucocytes and occasional large mononuclear phagocytic cells. In a few scattered foci a few red blood cells were intermixed. The lutein cells otherwise were pale, more or less vacuolated and granular. Many of these cells were apparently degenerating, but the nuclei remained vesicular. The cells nearer the blood vessels were perhaps a little better preserved, but in places the necrosis extended up to the capsule and to the blood vessels. The corpus was very vascular, and an occasional small hæmorrhage was observed in the supporting tissue, but none were found among the lutein cells. The vessels here presented no lesions, but many contained a few leucocytes. About the periphery of the corpus luteum a few well preserved, paralutein cells were found.

There were a few corpora albicantia in this ovary, but no follicles. No evidences of inflammatory changes were observed and the ovary was otherwise negative. Several sections of this ovary presented the same appearance.

In the cortex of the right ovary there were several small atretic follicles, with many interstitial cells, the majority of which occupied the position of the theca interna and closely resembled paralutein cells. In one field numerous large and pale phagocytic cells were found about a recent corpus albicans. This ovary was otherwise negative.

The musculature of the uterus presented the normal uniform hypertrophy of pregnancy. In the decidua here and there an occasional gland was found containing thick fluid and occasional neutrophilic polymorphonuclear leucocytes. The leucocytes were not found among the decidual cells. No fibrin deposits were found aside from the normal canalized fibrin. The vessels of the uterus and decidua were numerous and large, and a few small round cells were scattered about certain of the large sinuses. In addition, another section showed a good deal of infiltrating hæmorrhage involving the decidua, which was otherwise normal in appearance.

The placental tissue was normal aside from one very tiny patch of infarction. The villi had a well defined double layer of epithelium; the inner Langhan's layer and the outer syncytium.

The liver cells, especially those in the central portions of the lobules, contained numerous large and small fat vacuoles. The central cells in many instances were reduced to little more than a cell membrane enclosing fat vacuoles. The immediate central cells in general were atrophic. The nuclei were not pyknotic and necrotic cells were not found. The central capillaries were relatively large and apparently dilated, but passive congestion was not a feature. The liver cells in the mid zone and periphery of the lobules revealed no special changes. Cloudy swelling was not a feature of importance. The bile ducts, portal and hepatic vessels presented nothing remarkable.

The tubular epithelium of the kidney cortex was swollen and presented more or less the appearance of cloudy swelling. This, however, was somewhat modified by the presence of coagulated fluid in the lumina. The cytoplasm was granular but no colloid or hyaline droplets were found. Fat vacuoles were not observed. A fair number of cells had pyknotic nuclei, but the cells were not necrotic. The epithelium was everywhere intact. The glomeruli were greatly swollen and the capillaries were engorged. The capsules of the glomeruli contained much thick fluid. The vessels of the medullary portions were congested but hæmorrhages were not observed.

The essential lesions found in the lungs were extensive œdema and alveolar emphysema. The alveoli were dilated and even ruptured and practically all were filled with fluid and a few red blood cells. In places a few neutrophilic polymorphonuclear leucocytes were intermixed with the fluid which was indicative of a very early pneumonia. Black carbon pigment was abundant about the bronchial tree. There was also congestion.

The lymphoid tissue of the intestines was hyperplastic, but there were no other changes.

The pathological diagnoses were pregnancy, necrosis of the corpus luteum, œdema of the lungs, fatty changes of the liver, parenchymatous degeneration of the kidneys, hæmorrhages of the decidua, leiomyomata of the uterus, omental adhesions, and dilatation of the stomach and intestines.

CASE 2. Mrs. Mary W., a white woman of 40 years, complaining of constant vomiting, was admitted to the Allegheny General Hospital, September 6, 1924, on the obstetrical service of Dr. J. L. Gilmore and died September 13, 1924.

The patient had had typhoid fever at the age of 11. Menstruation began at 15 years, recurring regularly every 28 days, but recently the periods had become rather excessive. The last period was July 4, 1924. She had been married 19 years and had had 5 previous pregnancies, the first 2 of which were normal. There was a probable toxæmia accompanying the third pregnancy, characterized by vomiting, and an operative delivery followed. The last two pregnancies were accompanied by vomiting and the patient induced abortion upon herself, each time by the insertion of a foreign body into the uterus. No history of marked infection followed either manipulation. Otherwise the past history was negative.

The present illness began with vomiting in the latter part of August. Within a month the vomiting was protracted and food could not be retained. There developed about the time of the vomiting

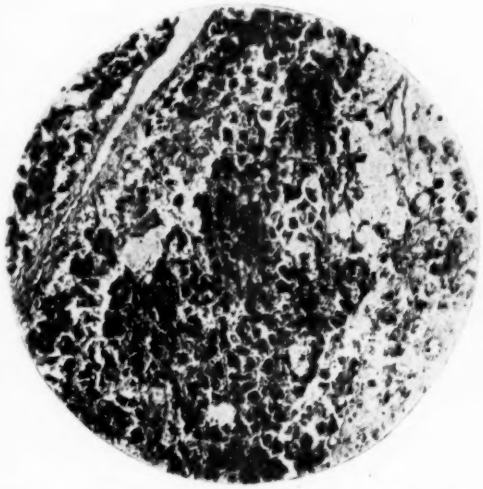

Fig. 3. Low power photomicrograph of Case 2, showing extensive coagulative necrosis of the corpus luteum and liquefaction of the more peripheral cells. Note also the pale degenerating cells on the right and to the right of the large vessel. The infiltrating leucocytes are well shown.

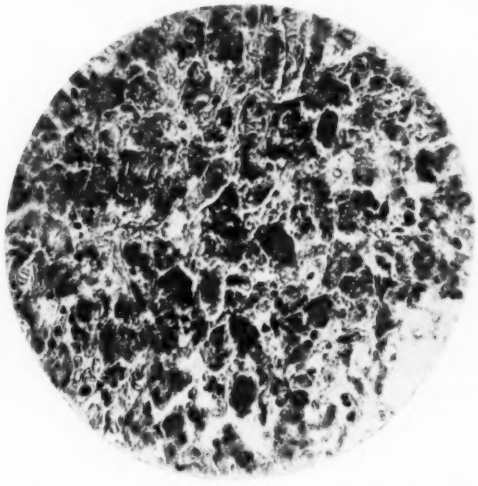

Fig. 4. High power photomicrograph of another field of the corpus luteum of Case 2, showing a few infiltrating polymorphonuclear and mononuclear cells among the necrotic cells and an area of liquefaction at the edge of the field.

visual disturbances and vertigo. Œdema was not noticed. The patient again tried to effect abortion by the introduction of a slippery elm stick into the uterus. This she did 2 weeks before admission to the hospital and a foul vaginal discharge promptly developed. The vomiting in the meantime became most severe and the patient lost about 20 pounds in weight. She had been exceedingly weak and confined in bed for 2 weeks or more before admission.

Physical examination showed a well developed middle aged white woman. Prostration and desiccation were marked. There was extensive oral sepsis, the mouth being dry and the tongue deeply furrowed. The thyroid gland was found moderately enlarged. The heart and lungs revealed no special abnormalities. The blood pressure was 126–74. The breasts were negative. The lower abdomen was slightly painful on palpation, but otherwise negative. The genitalia showed evidences of previous lacerations and there was a thin vaginal discharge. The cervix was soft and admitted the index finger. The uterus was moderately enlarged soft and movable, the size of a 2 months' pregnancy The adnexæ were painful and thought to be enlarged. The extremities and reflexes were negative.

Course in hospital. The patient had been unable to retain food or drink and the vomiting was most marked. Under sedative treatment, however, by September 9, the vomiting was less severe, but her general condition was considered poor. Large amounts of glucose solution were given under the breasts. The blood contained 67.4 milligrams of non-protein nitrogen, 1.74 milligrams of creatinine, and 140 milligrams of sugar per 100 cubic centimeters; white blood cells, 18,150; red blood cells, 5,768,000.

On September 10, the patient was able to retain a little food. The blood pressure was 118/82. The urine showed a trace of albumin, and sugar and acetone were slightly positive. Bile was present, and a few hyaline casts were found. The blood Wassermann was negative.

By September 11, the vomiting had practically ceased and the patient was able to retain a little food. The latter was given by stomach tube. Glucose solution was again given intravenously. The patient did not improve but gradually became lethargic. The blood pressure was 110–90.

Up to September 12, the temperature had been within normal limits, but this day it rapidly rose to 102.4 degrees F. The patient became toxic, delirious, and slight jaundice was noticed for the first time. The pulse was exceedingly rapid, 156 per minute (ascultatory). A terminal diarrhœa developed and the patient died the next day.

The temperature was irregularly elevated after the initial rise of 102.4 degrees F. and reached 103–105, and 107 degrees F. before death. The pulse rate had been rapid throughout, ranging from 110 to 126 per minute. The last 3 days the pulse rate reached 140 to 160 per minute. With the onset of fever the respiration became markedly accelerated, 40 to 60 per minute.

A clinical diagnosis was made of hyperemesis gravidarum accompanied by jaundice, desiccation, high non-protein blood nitrogen, evidence of an

endometritis, slight hyperglycæmia with glycosuria and evidence of slight acidosis.

Autopsy (by D. B.) was performed 1½ hours after death. The body was that of a large, well developed white woman. The skin and sclera showed a slight but definite jaundice. The moderately enlarged thyroid gland produced a noticeable fullness in the neck. The breasts, thorax, and abdomen were negative. The external genitalia were bluish and multiparous. A thin brownish fluid exuded from the vagina. The body was otherwise negative externally.

The soft and moderately enlarged uterus was lying free in the pelvis, the fundus just reaching the symphysis pubis. The adnexa were essentially negative *in situ*, as were the abdominal viscera. No evidence was found of peritonitis and the peritoneal cavity presented nothing of importance pathologically.

The thoracic cavity, with the viscera in place, was negative.

The heart, weighing 250 grams, was contracted and externally normal in appearance. The chambers and valves were negative. A few fair sized yellowish atheromatous plaques were found in the aorta. Otherwise the large arteries and veins were negative.

The right lung weighed 450 grams, the left 460. Both lungs were moderatly œdematous, exuding from the cut surfaces much frothy fluid. The dependent portions of both lungs were congested. No definite bronchopneumonia was demonstrated.

The thyroid gland weighed 125 grams, was considerably enlarged, nodular, and distorted. It almost surrounded the trachea, but did not compress it. Numerous adenomata, for the most part, made up the enlargement, the largest of which was 4.5 by 3.5 by 3.5 to 4 centimeters. On the cut surfaces, the appearance of the adenomata was typical and some were partially calcified; others showed central softening, but none were cystic. The intervening tissue had large alveoli which contained much pale glassy colloid.

The liver and gall bladder weighed 1,470 grams. Externally the liver presented nothing pathological. On section, the liver parenchyma as well as the capsular surfaces were uniformly dark in color. The lobules were not especially swollen and no scarring or other alterations were observed.

The gall bladder was thin walled and contained no stones and the bile ducts were negative.

The right kidney weighed 165 grams, the left 150. Aside from the purplish discoloration of congestion both kidneys were negative externally. On section they oozed much blood, but both were soft. There was slight swelling of the cortex of each kidney. The pelvic structures of each were negative.

The uterus was the size of a 3 months' pregnancy, symmetrical and soft. Its surfaces were smooth and glistening, except for a small patch of superficial veins forming a rosette situated on the fundus. The cervix was soft and revealed a healed bilateral laceration. Thick mucus exuded from the patulous external orifices. On section of the uterus, the fetus was found floating in clear amniotic fluid. The fetal membranes and placenta presented nothing pathological. The uterine muscle and the decidua were very vascular but appeared to be normal. The cervical tissue was dense and was cut with difficulty.

The fetus was 4.5 centimeters, crown-rump length and appeared normal. The umbilical cord was not remarkable.

The right ovary was larger than the left due to the presence of the corpus luteum of pregnancy in the median pole. No gross changes were recognized in the corpus, which had a uniform light yellow color. The ovarian tissue of the right ovary was solid. The left ovary was not grossly pathological.

The uterine tubes were essentially negative.

The vagina was negative.

A small firm, lobulated and gray nodule 12 by 6 millimeters with the appearance of an accessory pancreas, was found on the free surface of the upper jejunum. The large bowel and appendix were negative.

The bone marrow of the right femur was abundant and reddish brown in color.

The other organs, namely, the pancreas, spleen, suprarenal glands, breasts, urinary bladder, and stomach revealed nothing of special importance grossly or microscopically. The lymph nodes were negative. The central nervous system was not examined.

Culture of the heart's blood revealed no growth.

Microscopic examination. The material was fixed in Zenker's fluid and stained with methylene blue and eosin.

The sections of the corpus luteum in the right ovary revealed extensive necrosis. Large patches of cells, the nuclei of which were hardly recognized, had undergone coagulative necrosis. Among them were scattered a few neutrophilic polymorphonuclear and endothelial leucocytes. Occasional tiny fibrin deposits and elsewhere a few red blood cells were also found among the coagulated cells. About the periphery of these large patches the dead lutein cells were undergoing fragmentation and extensive liquefaction. Nowhere, however, were the nuclei pyknotic. In the blood vessels which were uninjured, a few neutrophilic polymorphonuclear leucocytes were also found. The corpus was very vascular, but there were no hæmorrhages. About certain of the vessels, the lutein cells were fairly well preserved and in a few places they appeared unchanged. The center of the corpus luteum was occupied by a small cavity containing coagulated fluid, the lining of which was of fibrous tissue. The supporting and capsular tissues of the corpus luteum presented nothing unusual. The few paralutein cells about the periphery showed nothing remarkable.

A very slight chronic peripheral inflammation was found which was characterized by a few buds of organized exudate infiltrated with a few mononuclear cells. The superficial cells of the mesovarium at one point, and many cells in certain of the patches of organized exudate, had undergone a very definite decidual change.

The left ovary had a fair number of interstitial cells in the walls of the atretic follicles. Inflammatory changes were absent.

The uterine muscle presented a uniform and well marked hypertrophy characteristic of pregnancy. The musculature under the placenta was very vascular. The decidua, especially in the superficial portions, had various large patches of exudate composed of neutrophilic polymorphonuclear leucocytes, with scattered fibrin deposits in addition. Where the exudate was abundant small patches of decidua were necrotic. One large sinus was found acutely thrombosed. The deeper layers of the decidua and glands were free from inflammatory changes. A few of the basal glands contained a thick fluid. The tissue was also more or less œdematous. Otherwise the decidua was negative.

The placenta was not pathological and both layers of epithelium covering the chorionic villi were easily differentiated.

The cervix of the uterus showed extensive inflammatory changes, characterized by a marked infiltration of plasma cells especially in the mucosa. The cervical epithelium was hyperplastic and thrown into low papillary-like growths. Between the epithelial cells and also lying in the glands were numerous neutrophilic polymorphonuclear leucocytes. Several tiny cysts or occluded glands were scattered about. An ulcerated patch covered by a leucocytic and fibrinous exudate was found at the external orifice. A moderate lymphocytic infiltration was found in the subepithelial tissues of the vaginal portion of the cervix. The musculature of the cervix was also hypertrophied.

The liver cells about the central veins were atrophic. A fair amount of coagulum was lying between the vessel walls and the liver cells throughout the greater portion of the lobules, but it was especially well marked centrally. Many of the central cells had pyknotic nuclei and some were fragmented. Here and there an occasional necrotic cell or cells were observed, surrounded by a few neutrophilic polymorphonuclear leucocytes. The majority of the central cells contained many small fat vacuoles. Other cells found in the central areas were reduced to little more than shadows, the cytoplasm apparently having been largely replaced by fat. The nuclei of these cells were pale. The central and the more peripheral cells as well, contained a fair amount of finely granular yellowish pigment. The more peripheral and mid zone cells showed very little change, aside from a few tiny fat vacuoles. No passive congestion was observed. The bile ducts presented no evidence of obstruction and the sections were otherwise negative.

The cytoplasm of the epithelial cells of the cortex of the kidney was granular, and the cells were swollen and irregular. Certain nuclei were pyknotic but no necrotic cells were observed. The tubules of the superficial cortex were dilated and contained a honey combed coagulum, a portion of which at least came from the cytoplasm of the lining cells. Elsewhere the changes were more or less typical of cloudy swelling or parenchymatous degeneration. The collecting tubules of the medulla contained a few hyaline casts. The glomeruli were swollen and congested and contained a honeycombed coagulum. The blood vessels were generally engorged, but there were no hæmorrhages. No evidence was found of acute nephritis or fatty changes. Otherwise the sections were negative.

The large adenomata of the thyroid gland presented essentially the same picture. They were made up of small, closely packed and well preserved alveoli, especially about the periphery, while the centers were largely loose fibrous tissue, degenerating alveoli and thick fluid. There was no evidence of hyperplasia of the alveolar epithelium, the cells of which were small and fairly uniform in size. Colloid was slight in amount. The capsules were composed of dense fibrous tissue. The smaller adenomata had poorly defined capsules, larger alveoli and the colloid here was not especially abundant.

The thyroid tissue proper was made up of large and irregular alveoli with flattened lining epithelium containing much colloid. Here the picture was suggestive of a colloid goiter. In certain of the larger alveoli were tiny intracystic papillomatous growths with a few scattered patches of small round cells. A few such cells were found in the adenomata.

The sections of the lungs showed a widespread œdema and a very fresh terminal bronchopneumonia. No tuberculosis or other chronic disease was found.

Sections from the small body on the jejunum revealed lobules of accessory pancreatic tissue, apparently functioning. The pancreatic ducts and islet tissue were well defined. Otherwise the intestine was negative.

At one point there was a slight ulceration of the mucosa, covered by a superficial leucocytic exudate. The lumen contained a fair number of neutrophilic polymorphonuclear leucocytes. No mononuclear exudate was observed. Otherwise the appendix was negative.

Bone marrow sections showed a diffuse and moderate degree of hyperplasia of the white and red blood cell elements.

The pathological diagnoses were pregnancy, necrosis of the corpus luteum, adenomata of the thyroid, jaundice, œdema of the lungs with a very early acute bronchopneumonia, fatty changes and œdema of the liver with a few necrotic central cells, parenchymatous degeneration of the kidneys, acute decidual endometritis, acute ulcerative and chronic cervicitis with old lacerations, acute ulcerative appendicitis, and accessory pancreas.

In the first case the subject was a primipara who presented the clinical features of pernicious vomiting in the third month of pregnancy. The illness was acute and progressive, terminating in death 44 days after the onset. The hyperglycæmia and glycosuria were

certainly the result of the liberal therapeutic use of glucose solution. The acidosis, as revealed by the urinalysis, was obviously the result of starvation. The albuminuria was apparently not marked. The uterine bleeding was not the result of an endometritis, and perhaps might have been the onset of a threatened abortion, had the patient lived long enough. Toward the end tachycardia, and later, fever, developed. Unfortunately no blood pressure readings were available.

Aside from marked pulmonary œdema, the postmortem examination, so far as the gross findings were concerned, revealed little of significance. Microscopically the extensive coagulative necrosis of the corpus luteum constituted by far the most important lesion. Certain of the lutein cells near the blood vessels were not greatly altered and seemed to be somewhat protected by their position. The liver revealed fatty changes, but not the usual central necrosis. The kidneys presented very definite parenchymatous degeneration, but nothing especially characteristic.

In the second case the clinical picture was also that of pernicious vomiting in early pregnancy. This patient was a multipara in the third month of gestation. When the patient entered the hospital after 2 weeks of almost constant vomiting, she showed evidence of desiccation and loss of weight. When she was first examined her condition was regarded as serious and the duration of the illness was less than a month. The presence of jaundice and the high non-protein nitrogen of the blood were unusual features worthy of note. The rapid pulse and fever were apparently terminal events. The high red and white blood cell counts were no doubt due to concentration of the blood from the loss of fluids. The leucocytosis, at least in part, was possibly associated with the acute endometritis. The slight hyperglycæmia and glycosuria, as in the first case, is to be attributed to the therapeutic use of dextrose. Here again one sees evidence of a slight starvation acidosis, as shown by the presence of acetone in the urine. Albuminuria was very slight. There was no hypertension.

With the exception of œdema of the lungs and the adenomatous goiter, the autopsy findings were not remarkable.

The important lesions microscopically were in the corpus luteum, and in the liver and the decidua. The acute decidual endometritis certainly followed the introduction of the foreign body into the uterus. The infection had not spread to any extent and apparently it was rather a low grade process. The chronic inflammatory lesions of the cervix appears to have been of long standing, while the acute exacerbation and ulceration were no doubt caused by the slippery elm stick.

The acute ulcerative appendicitis was not extensive and of little significance.

The pathological findings in the liver were not extensive, yet definite. There was a moderate degree of fatty changes in the central cells and in occasional lobules one or more necrotic cells were observed. The liver was also œdematous. The cause of the jaundice remains obscure, as the liver damage was hardly sufficient to explain it. Apparently, then, it should be considered of extrahepatic origin.

The kidneys did not present the characteristic necrosis of the tubular epithelium, but essentially a parenchymatous degeneration. The kidneys showed no evidence of nephritis and the high non-protein nitrogen of the blood remains unexplained.

The massive necrosis of the corpus luteum was by far the most marked lesion found. Rather extensive liquefaction of the dead lutein cells in this case is perhaps in favor of necrosis of longer duration than is that in the first case. The necrosis in this instance as in the first case represents an uncommon local degeneration. No other ovarian tissue was affected in either case but occasional capillaries of each corpus luteum were evidently slightly injured.

Two very similar cases of pernicious vomiting of pregnancy, both terminating in death, revealed for the most part a similar disease condition, especially of the corpus luteum. Both cases presented the rather characteristic fatty changes of the liver; however, in neither instance were the livers enlarged. Only in the second case were there necrotic central liver cells and these were not numerous. Central necrosis of the liver, though often observed, is not a constant finding in this disease. The

frequently found necrosis of the renal tubular epithelium was absent in each case. The lesions of the kidneys of neither were characteristic and were not unlike the degenerative changes occurring in any acute infectious or toxic disease.

The question at once arises as to the significance of the necrosis in the corpora lutea. From the appearance of each corpus luteum it seems probable that many of the necrotic cells had been there some time, sufficient time at least for these cells to have undergone a certain amount of fragmentation and liquefaction. Especially was this true of the second case. On the other hand leucocytic infiltration in this case was only slight. In the first case, leucocytic infiltration among the necrotic cells had advanced to a moderate degree, yet the majority of the cells maintained their form fairly well. The necrosis in both instances was primarily a coagulative necrosis. In neither case was there any evidence of repair. The form of each corpus luteum had been well preserved by the fibrous tissue framework. On the whole, in view of the gross and microscopic findings, it appears that the bulk of the necrosis was not of long duration and hence occurred late in the disease.

The necrosis in these cases probably resulted from the underlying toxæmias of which the patients suffered. It therefore apparently belongs in the same category with the central necrosis of the liver cells and also with that of the epithelium of the convoluted tubules of the kidneys, either or both of which may be found in this malady. Aside from the short life of the corpus luteum, there are no reasons why one should not expect necrosis of the lutein cells as well as that of any other parenchymatous structure. But why the necrosis should be so extensive in the corpus luteum and very slight or absent in the liver and kidneys, where it is usually found, is a question we cannot answer.

Realizing that the etiology of the toxæmias of pregnancy, and particularly that of pernicious vomiting is obscure, we do not propose to offer the necrosis and the obvious deficiency of the corpus luteum as the underlying cause of this disease. Certainly two cases cannot prove this point. It may be that this lesion of the corpus luteum is well known to some and perhaps has occurred in conditions other than hyperemesis gravidarum.

Obviously in these two cases there must have been a marked deficiency of the corpus luteum secretions. But how long this deficiency persisted and the character of the disturbances it no doubt caused are things we do not know.

It is to be hoped that, in the future, pathologists will routinely study the corpus luteum of pregnancy, whether or not it appears grossly pathological.

CONCLUSIONS

1. Necrosis of the corpus luteum may occur in pernicious vomiting of pregnancy.

2. Necrosis of the corpus luteum in pernicious vomiting of pregnancy probably has the same significance as has necrosis of the liver and kidneys in this disease.

We wish to thank Drs. James L. Gilmore and Harold A. Miller for the privilege of using the clinical records.

THE CORPUS LUTEUM AS THE SOURCE OF THE FOLLICULAR HORMONE

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SINCE Knauer (1899) proved by transplantation experiments that the action of the ovary on the genital tract was due to a hormone, a decided interest has been taken in the task of localizing the origin of this hormone in the various distinct tissues of the ovary. The follicle, interstitial cell, and corpus luteum have been cited as possible sources of it.

The idea that the corpus luteum is the tissue producing the hormone of the ovary was first suggested by Born and Fraenkel (1903). They believed the corpus luteum to be responsible for the implantation of the ovum and, in some way, to cause menstruation. Fraenkel tested the relation of the corpus luteum to the implantation of the ovum by extirpating the corpora lutea of pregnant rabbits and noting that the pregnancy was terminated if the operations were performed in the early days of pregnancy.

L. Loeb (1907) considered the corpus luteum necessary for the implantation of the ovum because of his studies on the production of deciduomata in the uterus of the guinea pig. He found it possible to produce deciduomata in the uterus by mechanical stimulation only at one period following œstrus; namely, when the corpus luteum had reached its greatest development. Loeb considers the effect of the corpus luteum to be that of a sensitizing agent rather than a factor in nutritional control as Fraenkel pointed out.

Ancel and Bouin (1910), working with the rabbit, confirmed Loeb's work. They allowed females to copulate with vasectomized bucks and noticed that corpora lutea were formed and that certain changes occurred in the uterus. These changes were considered as a preparation for the reception of the ovum.

That there is more than one ovarian hormone seems to be probable. However, in this paper we are concerned only with the hormone found in the follicles and wish to ascertain whether or not this hormone is also found in the corpus luteum.

Herrmann, in 1913, claimed the isolation of an unsaturated phosphatide which caused œstrus changes, but later altered his opinion about the character of the substance. Fellner (1913) also claimed the isolation of the female sex hormone as a lipoid. Fellner and Herrmann have since entered into a controversy as to the priority of the discovery of this hormone in the corpus luteum. Both of these men claim to have found a hormone causing hyperplasia of the genital tract in whole ovaries, corpus luteum, and placenta. The test animals used in their experiments were sexually immature female rabbits.

Frank and Rosenbloom (1915) tested the action of extracts of corpus luteum by lipoid solvents on the genital tract of female rabbits and found an increase in the length, diameter, and weight of the uterus following subcutaneous injections. A very decided difference was noted in extracts of corpora lutea from ovaries of pregnant hogs as compared with those obtained from non-pregnant animals. Extracts of the latter did not cause increase in the size of the uterus while the former gave a positive reaction. The ovaries for this experiment were collected by the packing company and it is interesting to note that the extract of corpora lutea from one batch of ovaries which inadvertently had been degreased by the packing firm gave only negative results.

Although Fellner, Herrmann, and Frank and Rosenbloom, all obtained positive results in inducing uterine hyperplasia with corpus luteum lipoid extracts, Okinschitz (1914) could obtain only negative results with his extracts.

The work of Allen and Doisy (1923) with the follicular hormone raised the question in our minds as to the production of the same hormone by the corpus luteum. We were especially anxious to test corpora lutea from swine on ovariectomized white rats in exactly the same manner in which such favorable results were obtained by Allen and Doisy with liquor folliculi. Hog corpora lutea, the principal source of the commercial extract, were generally used, although a few tests were made on sheep and cow corpora lutea.

EXPERIMENTS

Our first consideration was for the certainty of the tissue with which we were dealing. The necessity for careful collection of our material was impressed on us by the fact that one of our associates obtained a slightly positive result with an extract of corpus luteum made from ovaries which had been carelessly collected by a laboratory diener and allowed to stand for a time. We felt that we could not correctly say that our extract was from the corpus luteum unless we took care that there were no other tissues present and that there was no chance for postmortem diffusion of substances from other tissues into the corpora extracted. In order that we might rule out this possibility of contamination with other tissues, we gathered corpora lutea from hogs which had been alive but a few minutes before we clipped and rinsed the tissue.

The corpora lutea gathered in this way were then grouped as to size, consistency, color, and condition of the accompanying uteri. In some preparations we were careful to determine whether the hogs were pregnant or not, and, if pregnant, to note the size of the embryos present. The corpora lutea from pregnant animals were grouped into three groups: (1) Those having embryos up to 30 millimeters in length, (2) those having embryos up to 50 millimeters in length, and (3) those having embryos over 50 millimeters in length. We think, by this careful collection, that we have reduced to a minimum the danger of contamination of our material with substances from other parts of the ovary and that we are dealing with the corpus luteum alone.

TABLE I.—INJECTIONS OF CORPUS LUTEUM EXTRACTS INTO OVARIECTOMIZED RATS[1]

Prep. No.	Kind of corpora lutea	Amount of extracted tissue injected, Grams	Number of tests
19	Large, red	10	2
45	Red, solid, various fractions tested		6
72	Large, red		1
89	Large, red	60	2
103	Mixed, pregnant and non-pregnant	25	1
104	Mixed, pregnant and non-pregnant	20	1
105	Mixed, pregnant and non-pregnant	13	1
106	Mixed, pregnant and non-pregnant	20	1
113	Solid, pink	20	2
113a	Acetone fraction of 113		1
114	Solid, pink	12	4
117	Non-pregnant, solid, pink	10	3
119	Non-pregnant, yellow, fibrous	4	1
121	Pregnant, red, embryo 5 to 30 mm.	20	3
123	Pregnant, red, embryo 35 to 50 mm.	11	1
124	Pregnant, red, embryo over 100 mm.	10	3
128	Pregnant, red, embryo 5 to 50 mm.	20	2
129	Pregnant, red, embryo 50 to 125 mm.	25	2
130	Non-pregnant, large, pink, solid	20	1
127	Non-pregnant, large, pink, solid	20	1
133a	Pregnant, red, embryo 50 to 125 mm. (Purified by alkaline hydrolysis.)	20	1
165	Mixed, red	20	1
199	Mixed, red, purified by alkaline hydrolysis	35	1

[1]The results were negative in every experiment.

The extracts were made by the procedure described by Doisy, Ralls, Allen, and Johnston (1924) which consists essentially in the precipitation and extraction of the proteins with alcohol and subsequent purification with acetone and ether. As negative results are of doubtful value unless the experiments are adequately controlled, preparations from liquor folliculi and corpora lutea were made simultaneously by exactly the same technique. Preparations No. 133a and No. 199 were made by mild alkaline hydrolysis, and the non-saponifiable fraction was carefully purified. Its injection likewise produced negative results. This was done because the activity of the liquor folliculi preparations seemed to increase with the purification of the extract. Ovariectomized white rats and immature rabbits were used as test animals. For the estimation of activity in the rabbit we used a

TABLE II.—INJECTION OF OVARIAN EXTRACTS INTO NORMAL IMMATURE RABBITS

Litter mates	Rabbit No.	Preparation No.	Tissue extracted	No. of days injected	Amount of extracted tissue injected	Age of animals in wks.	Length in mm. of uterine horn	Diameter of uterus in mm.	Condition of internal genitalia	Results in terms of growth
A	857	143	Red corpora lutea	7	77 gm.	5.5	50	1	Uterus, oviduct and vagina small and anæmic	−
A	858	144	Liquor folliculi	7	77 gm.	5.5	80	4	Ovaries and tubes small; uterus and vagina large	++
A	859	145	Remains of ovaries from which No. 143 and No. 144 were taken	7	77 gm.	5.5	60	3.5	Uterus hyperæmic and slightly enlarged	+
A	856		Control animal		0	5.5	60	2	Uterus slightly pink, vaginal wall thin	−
B	853	147	Residues from pregnant corpora lutea No. 121, No. 128, and No. 129 (See Table I)	5	67 gm.	6	40	2	Uterus and tubes small and white	−
B	852		Control animal		0	6		1.5	Uterus small	−
C	816	447	No. 147 (see above) and No. 110	6	75 gm.	7		2	Uterus small and white	−
C	819	110	Liquor folliculi (highly purified). Total solids 8 milligrams	6	0	7		4	Uterus enlarged and slightly pink	+
C	818	257	Liquor folliculi and corpora lutea No. 110 and No. 147	6	0	7		4.5	Uterus enlarged and slightly pink	+
C	817		Control animal		0	7		1.5	Uterus small and white	−
D	820	147	Corpora lutea (see above)	4	50 gm.	4.5		0.8	Uterus very small; animal died 4th day with diarrhœa.	−
D	821	110	Liquor folliculi (see above)	4	10 gm.	4.5		2.5	Uterus and vagina enlarged and slightly pink	+
E	822	158	Corpora lutea, red, mixed	8	80 gm.	7		3	Uterus hyperæmic; animal died. Cause?	+
E	824	110	Liquor folliculi (see above)	8	25 gm.	7		5	Uterus very large, slightly hyperæmic	++
E	854		Water soluble commercial preparation of whole ovaries	8	0	7		1.5	Uterus small and anæmic	−
E	825		Control animal		0	7		2	Uterus small and anæmic	−

comparison of the condition of the genital organs of injected and uninjected litter sisters. For the rat we used the test originated by Stockard and Papanicalaou (1917) for the guinea pig and described as being equally suited for the rat (Long and Evans, 1922), mouse (Allen, 1922), opossum (Hartman, 1923), and monkey (Corner, 1923). The test consists essentially in the examination of the vaginal smear, which presents a very characteristic picture in the various phases of the œstrus cycle. It is possible by this method to follow closely, in the living animal, changes occurring in the genital tract.

In our experiments, injections were made in three portions during the day, the injections usually being about 4 hours apart. Tests of 42 extracts of corpus luteum were made in varying amounts. In no case was there a positive result with corpus luteum extract, regardless of the type of corpora lutea or quantity used. However, by a perusal of the protocol it will be noted that from liquor folliculi and whole ovary extracts positive results were always obtained with the extract of 0.5 to 3.0 cubic centimeters of liquor folliculi, while the extract of 10 to 60 grams of corpus luteum gave negative results. It will be noted that the

amount of liquor folliculi necessary to cause œstrus changes was much less than the amounts of corpus luteum injected. The animals upon which we tested our corpus luteum extracts were occasionally caused to have an induced œstrus cycle by the use of liquor folliculi to prevent the atrophy due to castration.

In our experiments upon rabbits, the corpus luteum extracts gave in no case a positive result. Five tests of our corpora lutea extracts were tried on rabbits. The rabbits were injected with extracts of from 50 to 80 grams of tissue over periods of 4 to 7 days. Very typical results may be seen in the set of litter mates marked "A." In this experiment the corpora lutea were clipped, the liquor folliculi was aspirated from the follicles, and extracts were made of corpora lutea, liquor folliculi, and the remaining "shucked" ovaries. Equal amounts of extracted tissue (77 grams) were injected over a period of 7 days. The results in each case may be seen in Figure 1. The uterus marked 857 is from the rabbit which had the corpus luteum injection, and it can easily be seen that it is smaller than the control 856. Number 858 received extract of liquor folliculi and number 859 received the extract of the "shucked" ovaries. Number 854 received injections of a water soluble commercial extract and no increase in size is noted.

We were anxious to see if the corpus luteum extract had any inhibitory effect on the action of the extract of liquor folliculi. Three litter mates "C" were used. Into each rabbit the extract of 75 grams of corpora lutea was injected, into another the extract of 75 grams of liquor folliculi, and into the third animal 150 grams of a mixture of equal parts of corpora lutea and liquor folliculi. If our corpus luteum extract had any marked inhibiting influence on the liquor folliculi extract, we should expect the uterus of the animal which had the two extracts to be smaller than the uterus of the rabbit which had only the liquor folliculi extract; but such was not the case, the uterus of the animal with the two extracts being larger by a very small amount. We cannot expect one experiment to prove this point, but the result seemed to be of interest.

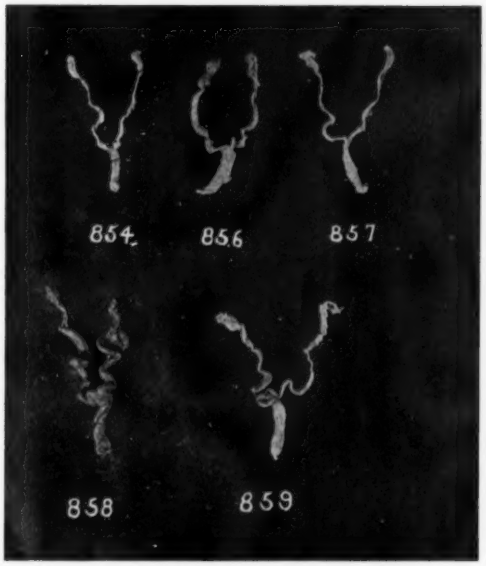

Fig. 1. Showing results of experiment in litter mates A.

SUMMARY

1. Corpus luteum has been cited as the source of the hormone which produces hyperplasia of the genital tract and some authors claim that extracts made by extracting corpus luteum with lipoid solvents are able to cause growth in the genital tract of certain mammals.

2. The amount of care exercised in collecting material is a factor which must be considered in order to be sure of the type of tissue obtained.

3. Using rats and rabbits we were unable to produce any noticeable changes in the genital tract by the injection of the alcohol, ether, acetone extract of carefully collected corpora lutea from pigs.

4. Pregnancy of the animals from which the corpora lutea were gathered, the size, consistency, or color of the corpora lutea had no effect on the results obtained.

5. We have obtained repeated positive tests with the alcohol, ether, acetone extract of liquor folliculi of hog ovaries and in view of this are inclined to believe that the corpus luteum does not secrete the hormone which produces hyperplasia of the uterus and vagina.

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RETROPOSITION OF THE UTERUS; A PRESENT DAY ESTIMATE

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THERE is perhaps no subject in the whole field of gynecology concerning which more divergence of opinion has been expressed than that of uterine malposition. The significance, prevention, and treatment of posterior displacement of the uterus are not adequately understood or properly evaluated by the rank and file of the medical profession. The theme of this paper was suggested by a consideration and studied interpretation of an authoritative editorial from the able pen of Arthur Dean Bevan (2) in the February, 1925, issue of SURGERY, GYNECOLOGY AND OBSTETRICS. With reservations we accept the conclusion that "the uncomplicated, movable, retroposed uterus produces no symptoms" and that "the time has arrived when operations done on women for retroposition of the uterus and for this condition alone are unwarranted, unnecessary, and indefensible."

SIGNIFICANCE OF RETROPOSITION OF THE UTERUS

Ample statistics have been collected by Stacy (12), Jaschke (8), and others, in support of the dictum that retroposition of the uterus *per se* does not produce symptoms and therefore does not require treatment. A concise analysis of this broad subject, however, demands recognition of the teaching, advanced by Thielhauber (14) in 1895 and confirmed by Baldy (1), Bovee (3), Clark (4), Findley (5), and many others, that the so-called symptoms of retroposition are not characteristic of the displacement but are indeed quite characteristic of the various complications that are so frequently incidental. Symptoms may vary in direct proportion to the kind and extent of the associated lesions. In general it is possible, on careful examination, to ascertain the particular pathology causative of gynecological symptoms in each case. Admittedly, in an occasional instance symptoms may be due to the mechanical dystocia but there can be no doubt that such is the exception to the general rule. That the primary displacement can be the cause of pathological sequelæ is the consensus of expert gynecological opinion borne out by definite clinical observation.

A study of 1,000 consecutive cases of retroposition of the uterus examined in the Clinic of Cornell University Medical College revealed the facts shown in Table 1.

TABLE I.—RETROPOSITION OF THE UTERUS

	Single women		Married women	
	No.	Per cent	No.	Per cent
Pathology				
Complicating pathology demonstrable on examination	53	53	816	90
Cervical disease	38	38	721	80
Adnexal disease	10	10	486	54
Adherent retroversion	11	11	261	29
Plastic dystocia cystocele, prolapsus, etc.	2	2	414	45
Symptomatology				
Leucorrhœa	48	48	668	74
Dysmenorrhœa	67	67	386	42
Backache	32	32	375	41
Menorrhagia	7	7	81	9
Sterility				

Of the 900 married women 214 or 23.7 per cent had never been pregnant.

In 73 or 8 per cent sterility was the chief complaint; 686 or 76 per cent had been pregnant.

Before drawing conclusions from these statistics or any similar tabulation, we must appreciate that the variety of pathological and symptomatic combinations in infinite. It is apparent that each case must be studied and treated on its merits, and there is no rigid rule that can govern the character and proper management of retrodisplacement of the uterus. The outstanding inference is that symptom producing retroposition is most prevalent among women who have been pregnant and that the causative pathology is demonstrable in the great majority of cases. We must assume that retrodisplacement of the uterus is always an anatomical abnormality, and it is not logical to insist that such an anomaly is normal for any woman, though frequently there may be no symptoms attributable to such displacement.

Retrodisplacement of the uterus may well be divided into two classes: the congenital or developmentally defective and the acquired types. The associated symptom producing condition may be similar in both types but there are differentiating details that must be recognized before proper judgment and treatment can be secured.

In the first or smaller group are those types found most frequently in unmarried girls or nulliparous women. This group is more apt to be of the non-symptomatic type and for that reason usually not associated with other pathological conditions requiring treatment. As Stacy (12) has shown, uncomplicated retroversion occurs in about 20 per cent of unmarried women and there is little difference in the character of menstruation and incidence of symptoms in cases of retroposition and in cases of anteposition of the uterus. The congenital retroposition is quite apt to be a local manifestation of a constitutional muscular and fascial deficiency. A general endocrine dysfunction and a genital insufficiency are frequently observed.

However, the second group, the acquired type, is the large group that demands intensive study and offers great promise both in the matter of prophylaxis and of permanent cure. This is so because this type comprises by far the larger number of cases of retrodisplacement and because it may be said that the acquired type is always associated with other pelvic conditions and therefore is symptom productive or potentially so. Even when no gross pathology can be demonstrated in careful gynecological examination and when competent orthopedic and neurologic study fails to account for symptoms, it is possible to assume the presence of some definite associated lesion. An example of this is frequently seen when the pelvic examination is negative except for mobile retroversion, yet the complaint, backache or menorrhagia, is relieved by a properly applied pessary, and the operative findings reveal definite varicocele of one or both broad ligaments and an associated hyperplastic endometritis. Admittedly, it is in the apparently uncomplicated mobile displacement that the most careful study and expert judgment must be employed.

PREVENTION

Little can be done in the prophylaxis of retroposition of congenital origin. General hygiene, diet, proper exercise, care of the bowels, more careful supervision of girls during puberty, with perhaps the occasional exhibition of glandular therapy, constitute the conservative palliative management of this condition.

It is fair to assume as Gellhorn (6) has insisted that every acquired retrodisplacement is pathological even if uncomplicated and must produce symptoms sooner or later. In the great majority of cases, acquired displacement is preventable by proper treatment following the termination of pregnancy. Any measure directed toward the rapid resolution of traumatic injury, the result of labor, will lessen the likelihood of malposition. Frequently, as Baldy (1) and others maintain, the related pathology is causative of the displacement. A lacerated cervix or perineum is often the cause of the subinvolution and consequent retroposition. Even in easy spontaneous delivery it must be assumed that definite damage to the structural anatomy of the birth passage is incurred. Overstretching and solution of continuity of the muscular and fascial layers may be submucous and yet often of greater etiological significance than the evident laceration through the mucosa. The ease with which the mucous membrane and fascia "slides" and assumes another and lower permanent attachment is obvious.

Although Howard Kelly in a recent "Review of Thirty Years of Gynecology" declared that he rarely employed "that obsolete instrument, the vaginal pessary," its sphere today is greater than in those early days when it was used as a "curative" agent. There is no better method of differential diagnosis than the employment of a well fitting pessary, as a "try-out" to determine the ability of maintained reposition of the uterus to relieve the symptoms complained of. If the pessary affords relief, one can expect a proper operative restoration to do as much or more. When manual replacement of the uterus is not easily accomplished a proper pessary and postural exercise will often correct an erroneous diagnosis of adherent displacement. Contra-

indications to the use of a pessary are easily recognized and the futility of pessary treatment quickly established. As an aid to promotion of complete involution by means of posture and exercises, a proper fitting pessary is the most effective means we have for the prevention of posterior displacement of the uterus. The routine insertion of an Albert Smith pessary at an interval after abortion, miscarriage, or labor, in conjunction with proper post partum care and follow-up observation will lessen the incidence of uterine malposition. A pessary should be worn for a period of from 1 to 6 months, and local treatment of cervical laceration and disease with the electro-cautery may be indicated.

The incidence of retroposition of the uterus following labor is placed by Lynch (10) at 41 per cent and by Paine (11) at 50 per cent. Probably if obstetrical cases were observed post partum over a much more extended period, greater prevalence would be noted. It is not unusual to find a fundus uteri in good position at 2 months after delivery and to find it in extreme retroversion at 6 months post partum.

TREATMENT

It is rarely necessary to treat retroposition of the congenital type. Marriage and pregnancy activate the genital physiology most favorably in many cases and unless the disability is severe, radical measures are only infrequently indicated. After competent diagnosis and observation, however, interference is often attended with excellent results. Rational conservatism demands, according to Stoeckel (13), that apparently uncomplicated, mobile retrodisplacement of the uterus, when causative of symptomatic complaint, be subjected to proper treatment. Recognizing the potential pathology and the predisposition to pelvic morbidity in uncomplicated posterior displacement, we find definite indications for palliative measures and, even as Grad (7) has maintained, prophylactic operation. While sterility may be the only complaint, when pregnancy and normal post partum involution occur, an absolute and permanent cure may result. As a rule, unless the uterus is maintained in good position after labor by a suitable pessary for an extended period of time, recurrence of the displacement takes place. Operative treatment is the proper procedure in very few cases of deficient structural development and even in this small group the likelihood of cure is slight indeed.

If the pessary treatment of the acquired type is instituted early enough, cure can reasonably be expected. As a rule when more than one year has elapsed after termination of the causative pregnancy, conservative treatment will not effect a cure; and yet depending upon the age of the woman and the character of her disability it is often evidence of superior judgment to defer operative treatment if transient relief can be obtained by such palliative measures. Not infrequently one may observe pregnancy supervene, and with the aid of continued pessary support for perhaps several months, efficient obstetrical care post partum may be rewarded by permanent cure of the displacement. In this condition as in all others, systemic hygiene and constitutional improvement will enhance all local treatment.

When, however, the condition has progressed to the stage of definite anatomical impairment and structural atrophy, no amount of postural or calisthenic treatment will suffice, and operative treatment is imperative. Of the hundred or more operations devised for the cure of retroposition of the uterus, it is perhaps fair to say that each and every one may in a properly selected case effect an anatomical or a symptomatic cure, or both. While a standardized technique will never be recognized as applicable to all cases of retroposition of the uterus, it is time that almost all of the known methods were thrown into the discard and that the few best ones be approved.

As Bevan (2) has well said, no surgeon has a right to perform an operation for fixation of the uterus that carries with it the danger of intestinal strangulation. There can be no doubt but that the number of such disasters as he has reported is on the increase due to the greater frequency of popular and easy methods of "uterine suspension." Every operation that "bridges" the abdominal cavity as in ventral fixation, Olshausen, or Gilliam methods should be abandoned. It must be admitted that gut strangulation is a likely possibility in every operation of such type.

The operation of greatest assured value is that of the modified Simpson or Montgomery subperitoneal technique which restores the uterus to its normal position with a minimum departure from the normal anatomical relations and physiological functions. Obviously any operative technique to be competent must include efficient care of all the associated pathology and contributing factors. A relaxed pelvic floor must be restored, a diseased cervix properly repaired, adnexal disease removed. Descensus of the bladder ranging from slight relaxation of the anterior vaginal wall to marked cystocele is so frequently present as to warrant the routine elevation of the bladder upon the anterior uterine surface in the manner described by Keefe (9). In extreme cases it is quite feasible to free the bladder from its cervical and vaginal attachment and perform an internal "interposition" operation, with sterilization if in the childbearing period, and the round ligament shortening of the Simpson-Montgomery method. Occasionally it is well to shorten the sacro-uterine ligaments or even obliterate the pouch of Douglas. Failure to account properly for any defect may jeopardize the success of the entire operative effort. It is fair to say that the retroposed uterus can be restored to its normal position by this Simpson-Montgomery technique modified to suit, with a minimum operative risk and with a maximum expectation of permanent cure. If properly done, no contra-indication to future pregnancy exists, no dystocia occurs; nor is recurrence after subsequent labor likely if competent post partum observation and care be provided.

There are cases in which the round ligaments are so deficient as to render the Simpson-Montgomery technique inadvisable and at other times it is anatomically impossible to bring the fundus forward in this manner. Frequently there is associated in these circumstances a prolapse of both adnexa with marked varicose veins of both broad ligaments and the operation of choice is that of the Baldy-Webster type which indeed is the most efficient means of providing adnexal elevation and support.

CONCLUSIONS

1. Congenital retroposition is rarely symptom productive and therefore it seldom requires treatment.

2. Symptom productive retroposition of the uterus of the acquired type is most common among women who have been pregnant.

3. Symptom productive retroposition will show on careful examination associated conditions, and the diagnosis will quite certainly be confirmed at operation.

4. More efficient and extended post partum observation and care will greatly lessen the incidence of acquired retroposition.

5. The vaginal pessary when properly used is an instrument of undoubted value and should be more frequently used to promote proper post partum involution.

6. Any operation that carries with it the risk of intestinal obstruction or uterine dystocia should be condemned.

7. The Simpson-Montgomery technique with proper care of associated defects offers the best prospect of cure.

8. In a few selected cases the Baldy-Webster technique is superior.

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A COMPARATIVE STUDY OF RADIATION AND SURGICAL TREATMENT FOR FIBROMYOMATA OF THE UTERUS[1]

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A COMPARATIVE study of representative groups of patients treated at the Mayo Clinic for fibromyomata of the uterus, either by operation or by radiation, has been undertaken to determine the late results of these methods of treatment and the incidence of complications. This has afforded at the same time an opportunity to review certain clinical phases of the presence of fibromyomata in relation to the symptoms and the general health of the patient. The 250 patients operated on represent those registering consecutively during 1918, for whom a diagnosis of fibromyomata of the uterus was made and who were referred for surgical treatment, while the 344 patients treated by radiation include a group from each year (1918 to July, 1924), because of the gradually changing dosage and technique of radiotherapy during that time.

Ewing asserts that 50 per cent of all women more than 50, and 20 per cent of those more than 25 have fibromyomata. The presence of demonstrable tumors is rare during puberty, although Leopold believes that the rudiments of them may be found in the uteri of children. The average age of the 250 patients at the time they presented themselves at the Clinic for examination and treatment was 42.9 years. The average age of the 245 patients treated by radium was 44.4 years; of the 65 treated by radium and roentgen rays, 46.3 years, and of those treated by roentgen-rays alone, 47.1 years. While the presence of tumors had often been detected many years before the menopause the symptoms apparently had not been troublesome until the patient approached that period.

The fact that the average age of the surgical patients is lower than that in the other groups might be construed as an attempt to apply to younger persons the treatment which is best adapted to conserving reproductive function. Surgical myomectomy is generally regarded as the method of treatment most likely to attain this object; there are many instances in the literature in support of this belief. For example, Gellhorn cites a case in which, after four large interstitial fibromyomata had been excised, the patient went to a normal full-term pregnancy. However, pregnancy with the birth of a normal child has also been observed following radiotherapy. Castaño, in reporting 250 cases of fibromyomata treated by radiation, states that three of the patients became pregnant following treatment. Of 1,013 patients treated with radium at the Mayo Clinic since 1915 Stacy found that 4 women had each had a living child; 3 others had given birth to dead fetuses; 1 had had two miscarriages and 1 was pregnant at the time of her report. In a series of 741 myomectomies reviewed by Stacy, 33 women later had a viable child, and 11 women 2 or more children. Schiller reports the history of a woman aged 43 who had never been pregnant. Premature menopause was induced by roentgen rays because of excessive bleeding. Definite fibromyomata were present in the uterus. Six months after the treatment menstruation reappeared once, after which the patient became pregnant and delivered a full-term baby which was normal at the last observation, 18 months later.

Of the cases reviewed in the present study, 3 in the surgical group were under 30 years, but in each case at operation myomectomy proved to be impracticable. Five of the patients treated by radiation were under 30. Three of the 5 had normal pregnancies following radium treatment, all of these being included among the cases reported by Stacy. Three were operated on because of a return of symptoms, while the fifth has not been heard from. Twenty-seven per cent of the patients treated surgically and 22 per cent of those treated by radiation were between 30 and 40. Thirty-eight were past the menopause, 19 in

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TABLE I.—CHIEF COMPLAINTS AND OBVIOUS SIGNS AT THE TIME OF ADMISSION

Symptoms and signs	Treated by radiation		Treated by operation	
	Cases	Per cent	Cases	Per cent
Profuse menstruation	95	28.0	63	25.0
Irregular bleeding	63	18.0	22	8.8
Pelvic pain on pressure	11	3.0	13	5.2
Lower abdominal pain	36	10.0	38	15.2
Cystitis or urinary symptoms	8	2.0	3	1.0
Dysmenorrhœa	8	2.0	16	16.5
Prolapsed uterus	2	0.6		
Backache	5	1.5		
Vaginal discharge	7	2.0		
Frequent miscarriages	1	0.3		
Pseudocyesis	1	0.3		
Weakness and fatigue	12	3.4	12	4.8
Presence of tumor noted	20	6.0	57	22.0
Symptoms unrelated	97	28.0	59	23.6
Tumor found in routine examination without symptoms	5	(29.5) 1.5	3	(24.6) 1.0

each major group; the average lapse of time since the menopause was 3.8 years. One patient, aged 76, who had passed through the normal menopause at 52, had first noted the pelvic tumor 4 years before her treatment at the Mayo Clinic, and during these 4 years the growth had been quite rapid. Instances of this type discredit the hypothesis that the growth of fibromyomata is stimulated by an ovarian hormone or interaction of ovarian and uterine tissues. Bland-Sutton says that fibromyomata arise in the uterus only during menstrual life; that after the cessation of menstruation they cease to grow, and some diminish in size. Although the growths may have been present during menstrual life, the following 2 cases cited by Trostler indicate that the excitation to growth may occur long after the ovaries have ceased to function.

A patient for whom a bilateral salpingectomy and oophorectomy had been performed at the age of 33, presented, 3 years later, a large smooth fibromyomatous uterus extending to within 7.5 centimeters of the umbilicus. The second patient, both of whose ovaries had been removed at the age of 35, had a fibromyomatous uterus extending to the umbilicus when she was 40.

Gibson observed the appearance and growth of a uterine myoma about 15 centimeters in diameter within 7 months after the removal of both ovaries. That the removal of ovarian

TABLE II.—TYPE OF MENSTRUATION

Symptoms and signs	Treated by radiation		Treated by operation	
	Cases	Per cent	Cases	Per cent
Profuse and prolonged	183	53.0	95	38.0
Irregular	123	35.7	42	16.8
Scanty	13	3.8	11	4.4
Regular, moderate	51	14.8	82	32.8
Continuous	11	3.0		
Painful	82	23.8	82	32.8
Past menopause with return of bleeding	11	3.0	14	5.6
Pelvic pain	67	16.0	73	29.0
Total	344		250	

hormones alone is not sufficient to reduce a fibromyomatous mass is indicated by the case reported by Gellhorn, of a patient aged 64, who, although bilateral oophorectomy had been performed as treatment for fibromyomatous tumors when she was 30, presented a mass still about 18 centimeters in diameter after the intervening 34 years.

The theory of ovarian stimulation of fibromyomatous growths has been the basis of the school of radiological technique, commonly described as the German school, which seeks to suppress ovarian function, in the hope that the resultant physiological reactions will reduce the uterine tumor. Opponents of this method contend that the roentgen-rays affect directly the neoplastic elements of the tumor and that the successful results with the German method of treatment are due to the inclusion of a part or all of the tumor in the fields of treatment (Table I).

Increased or prolonged menstrual flow is obviously the most common indication of the presence of fibromyomatous growths. It is well known that the fibromyomata may be symptomless for many years (Table II).

Ewing mentions sterility as one of the possible causes of fibromyomatous tumors. Among the large number of patients having fibromyomata, Young found sterility in 31 per cent, while for all women sterility was found in about 10 per cent. It is more generally believed that the fibromyomata are a cause of sterility by mechanical irritation or obstruction, rather than a result of it (Table III).

It has heretofore been considered that fibromyomata presenting a mass larger than

TABLE III.—FECUNDITY OF PATIENTS WITH FIBROMYOMATOUS TUMORS

	Treated by radiation		Treated by operation	
	Cases	Per cent	Cases	Per cent
Married	302		214	
No pregnancies	56	18.0	66	30.0
Miscarriages only	20	6.6	26	12.0
Nonsterile	246		148	
Average miscarriages	0.75		0.8	
With viable child	226		122	
Average children each patient	3.1		2.6	

TABLE IV.—SIZE OF TUMORS[1]

Treatment	Total cases	Grade 1		Grade 2		Grade 3		Grade 4	
		Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
X-rays	30	6	20.0	14	46.0	10	33.0		
Radium	224	177	79.0	44	20.0	3	1.3		
X-rays and radium	64	23	36.0	32	50.0	9	14.0		
Operation	240	61	25.0	86	35.8	79	30.0	14	5.8

[1] In a few instances accurate data with regard to size of tumor were not recorded.

TABLE V.—THE FREQUENCY AND TYPE OF PREVIOUS TREATMENT FOR OPERATIVE CASES

Treatment elsewhere	Cases	Treatment at Mayo Clinic	
		By radiation	By operation
Myomectomy	25	15	10
Unilateral oophorectomy	27	14	13
Partial bilateral oophorectomy	1		1
Cysts of ovary	10	4	6
Drainage of pelvic abscess	5	1	4
Dilatation and curettage	54	42	12
Polyps from cervix	5	4	1
Tumors from cervix (1 dermoid, others not specified)	9	2	7
Trachelorrhaphy	5	3	2
Internal suspension of uterus	19	17	2
Cauterization of cervix	1	1	
Hysterotomy	1	1	
Radium (2 had 2 applications)	3	3	
X-ray	1	1	

that of a 4-months' pregnancy are best cared for surgically. Recent reports by prominent radiotherapists indicate a tendency to disregard this limit. Béclère, in 1922, in a review of 300 new cases of fibromyomata treated by roentgen rays, cautions against treatment of an incarcerated pelvic tumor, but includes among cases successfully treated those with tumors extending 30 to 34 centimeters above the symphysis pubis.

In the present series the tumors have been divided into 4 grades according to extent: Grade 1, pelvic tumors; Grade 2, abdominal pelvic tumors up to one-half the distance from the symphysis to the umbilicus; Grade 3, tumors extending half way to the level of the umbilicus; and Grade 4, all tumors above this level (Tables IV and V).

From the pathological report following operation note was made not only of the percentage of error in diagnosis, but also of the incidence of any condition which might have caused complications had that patient been treated by radiation. Of the 250 patients operated on, 71 presented multiple fibromyomata, and 29 single fibromyomata without any pelvic complications determined by the surgeon or by the pathologist in the examination of the specimen. In 55 cases the tubes and ovaries were definitely described as normal. In 95 cases (38 per cent), however, chronic pelvic inflammation was found, although it had not been indicated by physical findings or history. In 10 cases tubo-ovarian abscesses were present. There is a general belief that the application of radium or the roentgen ray to inflammatory lesions is likely to cause an exacerbation. Presumably 40 per cent of the cases treated by roentgen ray or radium would show chronic pelvic inflammation if explored, while, as indicated in Tables VII to X, an active inflammatory reaction to radium or roentgen ray is relatively rare. Béclère has never encountered such a reaction to roentgenologic treatment although it occasionally follows the application of radium.

The percentage of errors in diagnosis is likewise noteworthy on the assumption that one might encounter the same degree of error in a similar group of patients treated by radiation. Among the conditions which may be so listed in the surgical group were 11 cases of unsuspected adenomyomata, 4 of carcinoma of the ovary, and 1 of sarcoma of the uterus. The question of degeneration of fibromyomata is particularly interesting in this regard. In this series there were 31 fibromyomata described by the pathologist as degenerating, 6 being calcareous, 5 very cellular, 4 necrotic, 2 œdematous, 2 hæmorrhagic, 2 cystic, while 8 were described as degenerating.

TABLE VI.—COMPUTATION OF THE POSTOPERATIVE RESULTS WITH THE AVERAGE PERIOD OF CONVALESCENCE

Operation	Cases	Effect on menstruation				Symptoms of menopause				Persistent vaginal discharge	Health improved		Health not improved		Average length of convalescence, mo.
		Ceased	Slight and irregular	Return	Had passed menopause	None	?	Moderate	Severe		Cases	Per cent	Cases	Per cent	
Subtotal abdominal hysterectomy without oophorectomy	56	50	6			9	9	24	9	10	47	84.0	8	14.0	6.4
Hysterectomy with excision of one ovary	64	54		11		15	7	27	8	1	52	81.0	8	12.0	4.5
Hysterectomy with excision of both ovaries	31	28			3	5	2	14	10	7	25	80.6	2	6.0	8.1

The inability to distinguish definitely, from the history or physical findings, between a degenerating fibromyoma and a fibromyoma with superimposed malignant disease or associated adnexal malignant disease constitutes the chief objection to the use of radiation for such tumors. It is undoubtedly a wise precaution for every patient treated by radiation to have a preliminary curettage. This seems imperative with a history of metrorrhagia or increased vaginal discharge. Even curettement, unless done with extreme care, may miss a small malignant lesion. Any question of adnexal attachment, or uncertainty about disease in the adnexa, should indicate an operation if the general health of the patient permits.

Masson refers to the difficulty in distinguishing simple degenerating or septic fibromyomata and polyps from true sarcomata, not only in gross specimens but even after microscopic study. He points out that, although sarcomata are occasionally found in the uterine wall and in the cervix, they are more common in pre-existing fibromyomata. In 4,322 patients operated on at the Mayo Clinic, from 1910 to 1921, for fibromyomata, he found sarcomatous change in 44 (1 per cent). Bland-Sutton believes such tumors to be malignant from their onset. Ewing deplores the tendency of gynecologists to search through all areas of benign tumors and to regard any variations in structure as sarcomatous change. He has found the ordinary tumors to vary in structure in different persons and probably at different age periods. Such changes may not be progressive. He, himself, has found only 3 malignant uterine fibromyomata with general metastasis, and 2 with local recurrences in an experience extending over 20 years. Winter did not discover malignant disease among 753 patients and concludes that malignant degeneration of fibromyomata must be extremely rare. Williams reports a case in which 4 polypi were removed from the uterus in a period of 5 years; the first was considered benign, the second and third were diagnosed small round-cell sarcoma, and the fourth seemed to be a benign tumor. After a period of 3 years there was no sign of recurrence. Béclère states that sarcomatous disease of uterine fibromyomata before and after the menopause is observed in less than 2 per cent of the cases, and from a clinical standpoint it is suggested by rapid growth, unusual softness on palpation, and general symptoms of cachexia. Frequent observation of the cervix during a course of treatment is advised by Béclère to detect protruding polypi which are generally considered suggestive of malignancy. In 1918, Wagner reported a case in which he believes sarcoma developed as a result of roentgenological treatment for fibromyoma. The consensus of opinion at the present time is that such a tumor was sarcomatous from the beginning, and roentgenological treatment simply caused necrosis of the growth and acute symptoms. Seitz and Wintz indeed recommend the use of radium and roentgen rays in all cases of doubtful sarcomatous change, since the operative results are known to be poor, while a sarcomatous growth is often checked by adequate radiation. Bland-Sutton found the average duration of life following operation for myosarcoma of the uterus to be less than 2 years, and the operation itself is attended with unusual risk. Radiation as the treatment

TABLE VII.—RESULTS OF RADIUM TREATMENT FOR FIBROMYOMATA

Dosage	Cases	Traced	Effect on menstruation					Effect on tumor					Symptoms of menopause					Health		Average length of convalescence, mo.	Later treatment	
			Ceased	Returned	No effect	Reduced in amount	Had passed menopause	Complete reduction	Partial reduction	Unchanged	Enlarged	Not traced	None	Mild	Moderate	Severe	Not traced	Improved	Unimproved		Radiation	Operation
Group 1 200 to 499 mg. hours	56	53	12	29	10	1	1	2	4	16	7	22	10	11	9	3	15	30	12	3.6	18	12
Group 2 500 to 999 mg. hours	150	135	78	57	7		3	20	19	17	4	88	18	19	46	11	37	87	25	3.9	20	21
Group 3 1,000 to 2,000 mg. hours	37	29	26	3				6	5	3		15	2	2	18		7	18	3	3.1	2	2
Group 4 Over 2,000 mg. hours	2	2	1	1						1		1			1		1	1	1	6.0		

of choice for any sarcomatous condition in the uterus was indorsed by the German Congress of Gynecologists of 1920.

Of the 250 patients operated on for fibromyomata replies to questionnaires have been received during the last year from 158; 21 others who did not reply had reported or had been seen at the clinic later than 1 year following the operation. For 71 patients no report of their late clinical result was available (Table VI). The results in hysterectomy with bilateral or unilateral oophorectomy have been differentiated chiefly to note whether the severity of the vascular phenomena associated with the menopause was roughly proportional to the amount of ovarian tissue removed. Apparently this is not a simple relationship but is largely influenced by other factors, notably the nervous temperament of the patient. As in all subjective symptomatology, it is difficult to evaluate the report of patients on this score, as intense discomfort for one patient will be described as a mild reaction by a more placid person. However, the fact that 2 patients still in active menstrual life had no hot flashes following double oophorectomy, while 9 patients complained of severe reaction following removal of the uterus only, indicates the variation in the replies.

Such symptoms as the persistence of vaginal discharge are, of course, not attributed to any deficiency or failure in the treatment of fibromyomata. I have endeavored, however, to note all of the pelvic symptoms which might necessitate later treatment by radiation or operation. Three patients were sufficiently annoyed by persistent vaginal discharge and irregular bleeding to require later amputation of the cervix. One reported extreme discomfort because of prolapse of the cervix.

Melson found that of 2,350 cases of subtotal abdominal hysterectomy for fibromyomata, in only 19 was carcinoma known to have developed in the stump of the cervix, a percentage of 0.8. Two of the patients in the present series had a small growth removed from the cervix later, and one of these now has a recurring growth, the removal of which is advised by her home physician. Another patient has a cystic tumor of the vaginal orifice. Increased pelvic pain led to the diagnosis of pelvic abscesses in 2 cases; these were drained in both instances. The abdominal wound opened in 1 case after the return of the patient to her home, while in 2 patients hernias developed at the site of operation. In 1 case complicated by bilateral tubo-ovarian abscess a vaginal fistula developed probably at the site of drainage, while in one carcinomatous case of bilateral cystadenoma a rectovaginal and vesicovaginal fistula developed with the recurrence of the disease. There is no evidence of a recurrence in the case reported sarcomatous.

Among the immediate surgical accidents was the death of one patient from pulmonary embolism on the eighth day, and of a second patient, whose primary operation was for ruptured appendix, from peritonitis on the twelfth day, surgical mortality of 0.8 per cent resulting.

A composite survey of results from radiation would be of little value, since the dosage and

TABLE VIII.—OPERATIONS SUBSEQUENT TO RADIUM TREATMENT (GROUP 1, TABLE VII)

Operation	Time since radiation, years	Cause	Pathological condition	Remarks
Dilatation and curettage	2.0	Recurrent attacks of fever and pain.	Pyometritis.	
First operation, cyst of left ovary Second operation, right pyosalpinx		Profuse flow.	No evidence of fibromyomata at second operation.	
Myomectomy	1.0	Return of profuse flow.		Patient later pregnant.
Subtotal abdominal hysterectomy	1.5	Continued bleeding.	Subacute pelvic peritonitis. Tuberculous abscess of right ovary.	
Subtotal abdominal hysterectomy	5 or 6 months	Continued bleeding and dysmenorrhœa.		Death from "ether pneumonia."
Subtotal abdominal hysterectomy	5 months	Irregular bleeding.	Multiple fibromyomata.	
Abdominal hysterectomy	8 months	Profuse flow.	Multiple fibromyomata, largest 11 centimeters.	
Abdominal hysterectomy	5	Irregular bleeding.	Extensive colloid carcinoma and multiple fibromyomata.	No symptoms after first radium treatment for 3 years, then irregular bleeding for 2 years. Radium and X-rays non-effective.
Abdominal hysterectomy	0.5	Growth in cul-de-sac.	Malignant.	Recurrent growth in 1 year.
Removal of growth near bladder	5	Pressure?		Patient had had repeated radiation. Uterus normal in size.
Type unknown	4.5	Return of profuse flow.		Patient had had normal pregnancy after treatment.
Type unknown	7.0	Continued bleeding.		

technique used during the period covered (1918 to July, 1924) has been greatly modified. One is accustomed to see in the literature general statements with regard to the result of radiotherapy or an arbitrary expression of preference for either radium or roentgen rays without sufficient data to enable the reader to test the conclusions. Of the 344 patients treated by radiation, recent replies have been received from 214 and reports from 91 later than 1 year after treatment, making a total of reports on 305 cases. Unfortunately, not all of the information requested was furnished by each patient; the percentages in the tables indicate only the positively ascertained results and will not always total 100.

The selection of either radium or roentgen rays as the therapeutic agent and the amount of each to be given depend largely on the situation and size of the fibromyoma. A small submucous fibromyoma responds usually to a small dose of radium; a larger tumor or a pedunculated tumor should receive a combination of radium and roentgen rays, or roentgen rays alone. For young women, who suffer chiefly from excessive menstruation with small fibromyomata, an effort is often made to treat with relatively small doses to maintain, if possible, a normal menstruation and the function of reproduction. The uncertainty of results in such instances is always carefully explained to the patient before the treatment is given (Table VII).

In Group 1, of the 53 patients reporting, 18 (34 per cent) required repeated radiation. Six patients complained of an irritating vaginal discharge following the treatment. Twelve patients were subsequently operated on (Table VIII).

Besides the cases mentioned in Table VIII, 1 patient developed a pelvic malignant disease, symptoms occurring 3 years after the radium treatment. One patient also had a normal full-term pregnancy, following which menstruation again became profuse and the initial dose of radium (350 milligram hours) was repeated. The patient died 1 week later, apparently from acute nephritis. This was the only death among the patients treated by radiation for nonmalignant pelvic diseases.

In Group 2, that is, those receiving 500 to 999 milligram hours of radium, further radi-

TABLE IX.—OPERATIONS SUBSEQUENT TO RADIUM TREATMENT (GROUP 2, TABLE VII)

Operation	Time since radiation, months	Cause	Pathological condition and remarks
Exploration	18	Irregular bleeding.	
Exploration	5	Irregular bleeding.	Malignant disease.
Cauterization of cervix	12	Irregular bleeding.	Carcinoma of cervix.
Curettage	Immediately	Abortion.	Three months' pregnancy; later treatment given to reduce fibromyoma.
Hysterectomy	9	Tumor not reduced.	Uterus matted in adhesions with inflammation of adnexa.
Hysterectomy	18	Tumor not reduced.	Adenomyoma of uterus.
Hysterectomy	9	Excessive flowing.	
Hysterectomy	18	Excessive flowing.	Multiple fibromyomata (1 subserous).
Hysterectomy	24	Excessive flowing.	Multiple fibromyomata, largest degenerating.
Hysterectomy	18	Irregular bleeding.	
Hysterectomy	18	Irregular bleeding.	
Hysterectomy	36	Irregular bleeding.	Multiple fibromyomata.
Hysterectomy	5 years	Pelvic pain.	Dense adhesions, both patients relieved by operation elsewhere.
Hysterectomy	1 year	Pelvic pain.	
Hysterectomy	18	Symptoms uncontrolled.	Carcinoma of uterus.
Hysterectomy	30	Symptoms uncontrolled.	Extensive adenocarcinoma of uterus, with secondary involvement of tube and ovary.
Hysterectomy	4 years	Acute appendicitis.	Appendectomy, pelvic tumor removed secondarily.
Hysterectomy	6	Tumor not reduced.	Multiple fibromyomata, left salpingitis with left hæmorrhagic cyst of left ovary.
Hysterectomy and myomectomy	12		
Hysterectomy with salpingectomy and oophorectomy	1	Acute pelvic inflammation.	Left pyosalpinx, degenerating fibromyomata.
Hysterectomy with salpingectomy and oophorectomy	1.5	Acute pelvic inflammation.	Extratubal abscess and pelvic peritonitis.

ation was given in 20 instances (15 per cent). Twenty-one patients were operated on (Table IX).

One patient, whose profuse bleeding was not controlled, died a few months after her treatment. Three patients have been advised to return for observation, each having reported symptoms suggestive of possible malignant change. Béclère's belief that a return of menstrual flow, not accompanied by prompt cessation of the vascular phenomenon of the menopause, is probably due to malignant disease of the pelvic organs, may prove helpful in the differential diagnosis in such cases.

One patient in this group illustrates an unusual continuance of ovarian activity. When she was first seen at the age of 61, the menstrual periods were irregular and profuse. On bimanual examination a large, hard, irregular uterus was palpated. Six hundred milligram hours of radium were applied in April, 1919. This was followed by cessation of menstruation for 8 months. In April, 1921, she was given 1,000 milligram hours of radium and menstruation ceased for four months. Since August, 1921, menstruation has been regular and profuse. The patient is in good health except for periods of weakness due to excessive flow.

In Group 3, patients receiving from 1,000 to 2,000 milligram hours of radium, only 2 are known to have received further radiation. Two were operated on, one 5 months after treatment because of dysuria for which the pressure of the fibromyoma on the bladder was responsible; the second, according to her local physician's report, at her own request, 6 months after treatment, in order to prevent later complications. The fibromyoma was apparently responding to treatment satis-

TABLE X.—RESULTS OF ROENTGEN-RAY TREATMENT

Type of roentgen ray	Cases	Traced	Courses of roentgen rays					Effect on menstruation			Effect on tumor					Symptoms of menopause				Health		Operation	Convalescence
			1	2	3	5	7	Ceased	Returned	Had passed menopause	Complete reduction	Partial reduction	Unchanged	Enlarged	Not traced	None	Mild	Moderate	Severe	Improved	Unimp.		
135 kilovolts	13	10	5	4	1	2	1	6	1	3	4	2	3			1		5	2	8	2	1	Usually no interruption in activities.
180 to 200 kilovolts	22	17	20	1	1			10		7	3	3	4	1	6	1	5	4		16	1	1 1 advised	1 month.

factorily at the time of operation. Two patients reported increased pelvic pain following the treatment. One patient, in whose case the diagnosis of benign uterine tumor was somewhat questionable from the first, but who because of obesity was considered a Grade 4 risk for operation, developed a very definite carcinoma of the fundus 5 years after her first treatment, and 2 years after the last application of radium. There had been a foul irritating vaginal discharge only partially controlled by radiation. Undoubtedly the uterus should have been curetted or extensively radiated at the first, in view of the possible presence of malignant disease.

Of the patients receiving over 2,000 milligram hours of radium, one had had previous roentgenological treatment for fibromyoma. On admission there was a marked degree of radiodermatitis over the anterior abdominal wall with an area of ulceration which when excised proved to contain epithelioma. Radium was applied for the reduction of the tumor. Three years later the patient returned with extensive pelvic carcinoma.

It is difficult to indicate satisfactorily the dosage of roentgen rays because of the multiple factors which may alter the resulting dose. In general the earlier patients (1918) were treated through several small fields (2.5 centimeters in diameter) over the symphysis pubis. Later the fields were enlarged, two being placed anteriorly to cover the lower abdomen and pelvis, with one or two corresponding fields posteriorly. A typical setting may be indicated by the factors: 135 kilovolt peak tension, 5 milliampere current, 6 millimeter aluminum filter, 40 centimeter skin focal distance, 40 minutes' exposure to each area. Occasionally an 0.5 millimeter copper filter was used with a corresponding increase in time of exposure. Since June, 1923, a number of patients have been treated with rays produced at a tension of from 180 to 200 kilovolts. A more severe systemic reaction to the more penetrating rays was anticipated but has not been encountered. In fact, the period of convalescence mentioned by the patients in this group has been actually shorter (Table X). There have been several instances of a more or less troublesome diarrhœa continuing in the most severe cases for 3 weeks. Three of the earlier patients developed an annoying first degree radiodermatitis; exposure has been reduced sufficiently to avoid this in later cases. With this voltage the tumor is undoubtedly more promptly reduced. The patients treated with roentgen rays of moderate voltage have been selected from those for whom repeated observations and treatment would not be inconvenient.

In Group 1, 1 patient whose uterine tumor had been satisfactorily reduced reports an operation 2 years later for a small growth near the bladder. Its nature was not reported.

Among those treated with roentgen rays of higher voltage, 1 patient who suffered particularly from pressure of masses on the bladder was unrelieved, and operation 1 year later showed a calcareous fibromyomatous mass impacted in dense adhesions. This patient should clearly have been refused radiation. The tumor had been present 12 years and was described as feeling unusually dense. In a second case, with a lobulated fibromyomatous mass extending to the umbilicus, the central mass was satisfactorily reduced while the lateral portions were enlarged; in this case operation has

TABLE XI.—RESULTS OF TREATMENT WITH RADIUM AND ROENTGEN RAYS (65 PATIENTS)

Dosage	Cases	Traced	Effect on menstruation					Effect on tumor					Symptoms of menopause					Health		Later treatment				Average length of convalescence, months
			Ceased	Returned	No effect	Had passed menopause	Not traced	Complete reduction	Partial reduction	No effect	Enlarged	Not traced	None	Mild	Moderate	Severe	Not traced	Improved	Unimprov.	Roentgen	Radium	Roentgen ray and radium	Operation	
Under 1,000 mg. hours radium and moderate voltage roentgen rays	21	19	2	5		2		1	8	2		8		1	10	3	5	16				4		8
1,000 to 2,000 mg. hours radium and moderate voltage roentgen rays	26	24	22	1	1			6	10		1	8	6	4	7	4	3	17	2	2	1	6	2	6
Over 2,000 mg. hours radium and moderate voltage roentgen rays	11	10	6	1	1	1		2	1	3		3	1	1	4	2		5	2		2	..	3	3.6
1,200 to 1,800 mg. hours radium and high voltage roentgen rays	7	6	5				1	3	1			2	1	2	2		1	5	1					0.75

been advised. I agree with Béclère that an adnexal mass not responding promptly to radiation should be regarded as probable malignant disease of the ovary.

The treatment of fibromyomata with roentgen rays is particularly free from serious complications. In no case has there been an inflammatory pelvic reaction. One patient with a history of recurring acute pelvic inflammations was treated without reaction. Three years later her admission for treatment of acute pelvic inflammation demonstrated the potential activity of the focus. No deaths from the use of roentgen rays have as yet been reported, although the number of cases so treated is constantly increasing. Béclère reports with his technique (which would correspond most closely to the Mayo Clinic 135 kilovolt setting) favorable results in the arrest of excessive menstruation in 98 per cent of cases, and complete reduction of tumors in 24 per cent.

The two operations noted in the second division of Table XI were due to failure to reduce the tumor, and in each instance a benign growth was found. In the third division, however, the tumors operated on were definitely malignant. Two patients offered serious surgical risk on account of obesity and exsanguination from profuse hæmorrhage. One was operated on 4 months after the radiation treatment, and extensive carcinoma of the body of the uterus and multiple fibromyomata were found. The second patient was explored elsewhere 8 months after her treatment and inoperable malignant neoplasm found. In the third case the size of the tumor remained satisfactorily reduced for 3 years after 2 courses of radium and roentgen rays. The tumor then enlarged rapidly. The patient was operated on elsewhere and a portion of the pelvic mass removed. The condition was reported to be malignant. One patient suffered from a radiodermatitis from too frequent courses of roentgen rays. Areas of telangiectasis appeared over the abdomen, and for a period of 2 years small areas occasionally showed ulceration, but they eventually healed.

Among all the groups the period of convalescence is only roughly indicative of the degree of reaction. Patients who report a convalescence of several years, following an application of less than 500 milligram hours of radium, have undoubtedly confused other causes of poor general health with the particular inconvenience caused by the treatment. Many patients in all groups found that they were able to continue their usual activities without interruption.

CONCLUSIONS

In these unselected cases of fibromyomata of the uterus treated by operation and by radiotherapy, a relatively high percentage of the latter group has been found to require further treatment, either repeated radiation (18 per cent) or operation (13.7 per cent), as compared with 4 per cent of the surgical group who received further treatment. It is true, however, that more recent cases, particularly after roentgenological treatment, are showing definitely better results through greater expe-

rience in the dosage required. A study of individual cases shows so many thoroughly satisfactory results with radiotherapy that the discrepancy in the total results must apparently be attributed to injudicious selection of cases, or to inadequate dosage. Great care must be exercised to rule out malignant disease at the time of radiation. Curettage should precede treatment in any case with suspicious symptoms. Inflammation, while apparently uninfluenced by radiation *per se*, as is shown by the lack of reaction to roentgen rays, is undoubtedly occasionally aggravated by the manipulation incident to the application of radium. Unusually hard fibromyomata containing extensive calcium deposits cannot be reduced satisfactorily by radiation; an incarcerated pelvic tumor is undoubtedly best removed surgically because of the inability to exclude adnexal disease. A roentgenogram may occasionally aid in detecting calcium deposits within a tumor.

The need of extreme care in excluding malignant disease is indicated by the fact that in 6 of the patients treated by radiotherapy a well established malignant process appeared within 1 year of the treatment. One other patient has probably malignant disease of the ovary, but refuses operation. Two others developed malignant disease within the 2 years after treatment, although in 1 case this may be considered a recurrence of the epithelioma in the abdominal wall at the time of radiation. In 4 patients, who remained free from symptoms for 3 years following treatment, malignant disease appeared. This may not be a higher percentage than that of pelvic malignant disease for all women at their age (1.1 per cent). However, it raises the question whether a focus of relatively devitalized tissue with altered blood supply may favor malignant change. I believe that complete subsequent histories should be kept for all patients treated with radium or roentgen rays so that we may have more data relative to this subject. One death (0.29 per cent) followed the application of a small amount of radium, and there were two surgical deaths (0.8 per cent), one of which must be attributed rather to the primary operation, the removal of a ruptured appendix.

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THE BLOOD CALCIUM IN ECLAMPSIA

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An investigation of the blood calcium findings in eclampsia was prompted by the following considerations suggesting a possible etiological relationship between the two. In the first place, it has been demonstrated that infantile tetany is associated with a decrease in blood calcium. Because of the clinical similarity of the latter condition and eclampsia it was only natural to expect similar findings here. In the second place, it is evident that the mineral metabolism of the maternal organism is enormously increased during pregnancy. This is especially true of calcium in the latter half of pregnancy, at which time a large amount of calcium is taken from the mother for deposition in the fetal bones. Consequently, it seemed logical to assume that when the mineral metabolism of the mother is unable to stand this calcium drain, a calcium poverty, manifesting itself in a hypocalcæmia, would result; and that this condition possibly had some relation to eclampsia.

Furthermore, it is well known that during pregnancy osseous changes take place in the mother, such as softening of the bones and dental decay, all of which might be interpreted as evidence of disturbed calcium balance. It is a statistical fact that eclampsia is much more common in twin pregnancies. The increased calcium utilization in this condition would tend further to support the hypothesis that eclampsia may be due to a decrease of calcium in the blood.

THEORIES OF ECLAMPSIA

The theories of the pathogenesis of eclampsia that have been proposed from time to time are legion and cannot be discussed here, nor even enumerated. However, for the sake of avoiding confusion, it is well to realize that practically all the theories proposed fall in one or another general group. These theories are that eclampsia may be the result of: (1) intoxication of the mother with the products of fetal metabolism; (2) of the entrance of the fetal or maternal elements into the maternal circulation; (3) of anaphylactic reaction; or (4) of the disturbance of maternal metabolism.

There are several theories concerning the pathogenesis of eclampsia that have been advanced in the last few years which have not as yet been cast among the discards. In 1923, McQuarrie (20) showed that in eclampsias there is a greater proportion of incompatibilities between the maternal and fetal blood types than in normal pregnancies. He therefore expressed the opinion that eclampsia may be due to agglutinative changes caused by the incompatible fetal blood gaining entrance to the maternal circulation. It is interesting to note that in 1905 Dienst (3) reported similar findings. Talbot (23) advanced the theory that eclampsia is caused by chronic sepsis, especially that due to infected teeth.

It has been repeatedly shown that, although the non-protein nitrogen in the blood is as a rule increased in eclampsia the urea nitrogen is proportionately diminished, while the other known nitrogenous elements are practically unaffected. This results in a considerable increase in the undetermined nitrogenous bodies. This finding has led to the expression by several (15, 16, 19) that the etiology of eclampsia may be linked up with these undetermined nitrogenous substances.

The possible association of mineral metabolism with eclampsia has been rather neglected. In 1910 Mitchell (21) expounded the theory that calcium deficiency is the cause of eclampsia. In support of his theory he cited certain theoretical considerations, several of which are mentioned in the first part of

this paper. He claims to have obtained satisfactory results in eclampsia by feeding calcium salts. He gave absolutely no laboratory data in support of his views, and his suggestion was promptly forgotten.

In 1911 Drennan (4) wrote the following: "Puerperal eclampsia may be caused by a toxæmia the result of a fatty infiltration first and following that, a fatty degeneration of the liver cells, due to the abstraction by the fetus of the calcium which should normally unite with the neutral fat in these cells to form lipoids whereby it could be removed to its—neutral fat—natural depots in the body."

LITERATURE ON CALCIUM

In reviewing the literature on blood calcium one should have in mind the following important facts. The figures given by different authors have not the same significance because some express the findings in terms of milligrams of calcium per 100 cubic centimeters of whole blood, others in terms of plasma, and others in terms of serum. Furthermore, the methods of quantitative determinations are not always the same and in many cases are now considered unreliable. In this paper, unless otherwise noted, the figures refer to milligrams of calcium per 100 cubic centimeters of blood serum.

Normal calcium figures for the adult as determined by Howland and Marriott (6) in 1916 are 9 to 11 milligrams per 100 cubic centimeters of serum. Halverson, Mohler, and Bergen (5) give the average for normal men as 10.2 milligrams. Lyman (17), in a series of cases, reports an average of 6.1 milligrams per 100 cubic centimeters of whole blood for normal men and 7.1 milligrams for normal women. Working with older methods, Jansen (7) reports somewhat higher findings, 11.5 to 12.0 milligrams per 100 cubic centimeters of serum.

Calcium figures for normal pregnancies vary somewhat with different authors. Jansen (7) gives 11.5 to 12.0 milligrams for pregnancy and puerperium, which is the same as for his normal controls. Krebs (13) reports normal figures for early pregnancy and slightly lowered figures for the latter half of pregnancy. Widdows (24) gives similar findings to those of Krebs. Many other observers, such as de Wesselow (2), Mazzocco (18) and Aymerich (1), report no appreciable changes in the blood calcium during pregnancy. Linzenmeier (14) claims that he has found the calcium increased in the latter half of pregnancy.

The literature on the blood calcium in eclampsia is extremely meager. There are many reports (8, 11) on calcium content of the blood in various pathological conditions in which eclampsia is not mentioned. In 1913 Linzenmeier (14) writes that in 5 cases of eclampsia he found no decrease in calcium. Morley (22), in the same year, by an indirect method of precipitating with oxalic acid and counting the crystals, found a decrease of calcium in pregnancy. He concludes: "From these considerations is it too much to hope or to prophesy that some day the unsettled etiology of the toxæmias of pregnancy may be explained by some disordered calcium economy on the part of the patient?"

Again, Kehrer (10), elaborating on his earlier work, reports findings of calcium deficiency in eclampsia. His figures are based on whole blood determinations. His normal pregnancies give the following figures: maximum, 7.26; minimum, 5.79; and average 6.46 milligrams. In a series of 24 cases of antepartum eclampsias his figures are: maximum, 8.04; minimum, 4.1; and average, 5.48. In several cases of postpartum eclampsia his figures are: maximum, 8.41; minimum, 5.52; and average, 6.95. An analysis of these results shows that Kehrer is not justified in his conclusions. In the first place, his reports are based on whole blood determinations, a procedure which has been repeatedly shown to be unreliable. In the second place, although his average figure for antepartum eclampsias is lower than that for normal pregnancy, the fact remains that his maximum figure is higher than that for normal pregnancy. Furthermore, his postpartum eclampsias show an average of calcium considerably higher than his normal pregnancies. In view of the above it cannot be said that Kehrer's results support his conclusions.

In 1917 Halverson, Mohler, and Bergen (5), in a series of normal and pathological cases,

report 1 case of eclampsia with a finding of 8.5 milligrams per 100 cubic centimeters of serum. Krebhiel (12), in another series of cases, mentions a case of eclampsia with the finding of 4.29 milligrams of calcium per 100 cubic centimeters of serum.

From the above consideration it is evident that either because of faulty technique or failure to present a sufficient number of cases the findings of calcium in the blood serum is as yet an unsettled matter. And it is with that in mind that the following investigation is recorded.

TECHNIQUE AND SCOPE OF WORK

The determination of calcium was done according to the method of Kramer and Tisdall. Blood was drawn from the arm and the serum separated. Whenever possible 5 cubic centimeters of serum were used in the determinations. To the serum in a 15 cubic centimeter centrifuge tube was added one-half its volume of a 3 per cent solution of ammonium oxalate. This was allowed to stand until the following day. The sides of the tube were then rubbed with a rubber-tipped glass rod. The tube was centrifuged at high speed for about 10 minutes, the liquid carefully decanted, distilled water added, and centrifuged again. This washing process was repeated three times. To the washed sediment were added 5 cubic centimeters of normal sulphuric acid and the tube kept at a temperature of 75 degrees C. This solution was titrated with a one-hundredth normal solution of potassium permanganate. The end point was considered that point at which a faint pink remained over 15 seconds. The calculations to be used are based on the fact that each cubic centimeter of permanganate solution represents 0.2 milligram of calcium.

The blood calcium values of several cases of normal pregnancy were determined, all of them shortly before delivery. The results are recorded in Table I.

Twelve cases of pre-eclamptic and eclamptic toxæmias were examined, with the results as shown in Table II.

Several other cases, at first considered as eclamptic but later proved to be erroneously diagnosed, are reported in Table III.

TABLE I.—BLOOD CALCIUM IN NORMAL PREGNANCY

Patient	Mg. calcium per 100 c.c. serum
M. G.	10.69
E. M.	10.69
C. P.	10.15
P. N.	10.89
R. Mc.	11.38
C.	12.00
F.	10.80
L. B.	11.25
S. K.	10.40
N. R.	11.52
F. P.	10.93
Average	10.94

TABLE II.—BLOOD CALCIUM IN PRE-ECLAMPSIA AND ECLAMPSIA

Patient	Diagnosis	Mg. calcium per 100 c.c. serum
F. R.	Eclampsia	10.10
W. B.	Pre-eclampsia, twins	9.20
E. P.	Eclampsia	10.00
A. E.	Pre-eclampsia	9.33
M. F.	Pre-eclampsia	10.00
A. L.	Postpartum eclampsia	10.66
A. J.	Eclampsia	12.00
W. D.	Eclampsia	9.60
M. C.	Postpartum eclampsia	9.71
C. A.	Postpartum eclampsia	10.40
M. H.	Intrapartum eclampsia	11.20
N. B.	Eclampsia	10.32
Average		10.21

TABLE III.—BLOOD CALCIUM IN CONDITIONS SIMULATING ECLAMPSIA

Patient	Diagnosis	Mg. calcium per 100 c.c. serum
M. C.	Uræmia	8.50
K. W.	Chronic nephritis	9.60
R. E.	Epilepsy	10.50
N. M.	Cavernous sinus thrombosis	9.60
Average		9.55

It is evident from the above tabulations that although the calcium figures for eclampsia are somewhat lower than those for normal pregnancy, the difference is rather negligible. Furthermore, in several cases of pathological conditions simulating eclampsia clinically it can be seen that the calcium figures are lower than those for eclampsia.

Other points of interest that have been observed in the cases of eclampsia here recorded are worthy of mention. A history of possible disturbance in calcium metabolism was inquired into in all these cases. None of them gave any history of delayed dentition or walking. None of them had had any recognizable tetany or rachitis. None of the eclamptic

women had ever suffered any previous pregnancy toxæmias.

SUMMARY AND CONCLUSIONS

In a study of the blood calcium level in eclamptics it has been shown that:

1. On theoretical grounds a decrease in the blood calcium may be expected in eclampsia.

2. The literature on this subject does not definitely clear this point.

3. In this research it has been demonstrated that there is no appreciable relation between the blood calcium and eclampsia.

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CYSTS OF THE SEMILUNAR CARTILAGES[1]

Report of Two Cases of Cyst of the External Semilunar Cartilage and One Case of Cyst of the Internal Semilunar Cartilage

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and
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In a recent article on cysts of the external semilunar cartilage by M. Jean, three new cases of this unusual condition were added to the literature, making a total of 18 cases reported up to that time. Accompanying the report was a review of all previously reported cases and a careful histological study of two of the specimens. This study was made in an endeavor to throw some light upon the etiology of the condition and to adduce evidence in favor of or against the presence of an endothelial or an epithelial lining in the cysts.

The histological study of the specimens was done by Professor Latulle and Dr. Seguy of St. Anne's Hospital in Paris. They found the specimens so similar that one description would serve for both of them.

Like all cysts previously reported, these were multilocular and located near the external border of the midportion of the external semilunar cartilage. A composite picture of the development of the cyst was constructed by a description of the different stages in the development of the cyst as shown by different portions of the specimens.

The earliest visible evidence of change in the tissue was a localized œdema which gave the characteristic staining reaction of degeneration. The tissue then became amorphous, followed by a stage in which it seemed fibrillar. Spaces formed between these fibrils and filled up with a nuclear débris. The walls of the cyst showed no epithelial or endothelial lining but, what on superficial examination was thought to be an endothelial lining, on careful examination proved to be a layer of the cyst contents which had become adherent to the walls of the cyst. There was no evidence of hæmorrhage or disease of the blood vessels in the tissues examined. There was an increase in the number of cartilage cells in the diseased tissue.

The French investigators reached the conclusion that the condition under discussion was a pseudocyst due to degeneration of fibrocartilage from unknown cause.

Phemister (2), in the first 2 cases reported from this country, found a lining of mature connective tissue.

Ollerenshaw (4) was the only one to report the finding of an endothelial lining.

At this time we wish to report 2 new cases of cyst of the external semilunar cartilage and one new case of cyst of the internal semilunar cartilage. While in some respects the cyst of the internal cartilage resembles the case reported by Fisher (3), yet this cyst was so much a part of the cartilage that it could not be removed without removing the cartilage and therefore has been classified as a cyst of the cartilage rather than as a cyst between the cartilage and internal lateral ligament as was done by Fisher.

Case 1. Y. K., a female, 21 years of age, came to the Orthopedic Outpatient Department of the Massachusetts General Hospital on December 9, 1924, complaining of pain in the right knee of 1 year's duration, and difficulty in walking after resting. She could remember no injury to which to ascribe the condition.

Examination disclosed a localized resilient swelling about the size of an American walnut on the lateral aspect of the right knee in approximately the joint line. It was tender on pressure. The mass was under the external lateral ligament and was evidently adherent to the deep structures upon which it rested. Pain was relieved by flexion of the knee to 80 degrees. Roentgenograms showed a soft tissue shadow at the point corresponding to the location of the tumor mass. The blood Wassermann was negative.

A diagnosis of cyst of the external semilunar cartilage was made, the patient admitted to the ward and operated upon on January 8, 1925. A transverse incision was made over the lateral aspect of the knee directly over the tumor mass. When the fibers of the external lateral ligament were separated the tumor pushed through into the opening. The cyst with the semilunar cartilage was removed (Fig. 1).

[1]From the Orthopedic Surgery Department of Massachusetts General Hospital, Boston, Massachusetts.

Fig. 1. Fig. 2. Fig. 4.

Fig. 1. Actual size drawing of coronal section through semilunar cartilage and cyst of Case 1. Defect in upper margin of drawing represents the principal cyst cavity which was opened to permit inspection of the cyst. Smaller cysts can be seen below. Remains of semilunar cartilage on extreme right.

Fig. 2. Actual size drawing of coronal section through specimen removed in Case 2. Defect in extreme right represents the principal cyst cavity with numerous smaller cysts to the left. Remains of cartilage on the extreme left.

Fig. 4. Actual size drawing of specimen from Case 3 showing the main cyst cavity.

On section the cyst was found to be filled with a mucoid substance tinged with red.

The patient made an uneventful convalescence and was discharged home on January 18, walking with the aid of crutches without pain.

February 18, 1925, she was discharged from care. At this time she had no pain, was walking without support, and had a full range of motion in the knee.

Case 2. N. W., a female, 30 years of age, came to the Orthopedic Outpatient Department of the Massachusetts General Hospital in February, 1925, complaining of pain in the left knee of 2 years' duration. She ascribed her trouble to an injury which she received in a trolley car collision immediately before the onset. The pain was intermittent at first and gradually became worse. The condition had been diagnosed as rheumatism and had been treated without relief.

Examination disclosed a definite localized resilient tumor mass over the external aspect of the left knee in the joint line and directly above the head of the fibula. The mass, about the size of an American walnut, was located under the lateral ligament and attached on its deep surface to the structures beneath it. The mass was tender on pressure. Pain was present on complete extension and on flexion to 90 degrees. Patient walked with a slight limp.

A diagnosis of cyst of the external semilunar cartilage was made, the patient was admitted to the ward and operated upon on February 25. A vertical incision was made over the site of the tumor mass and when the fibers of the external lateral ligament were separated the tumor pushed up into the incision. It was found to be continuous with the external semilunar cartilage and was removed together with the entire cartilage (Fig. 2).

Examination of the cyst showed it to be in the semilunar cartilage, multilocular in character, and filled with a reddish mucoid substance (Fig. 3).

On April 3, 1925, the patient was able to walk freely without aid and had a range of motion of 70 degrees, from 5 to 75 degrees. No pain or tenderness was present.

Case 3. P. V., a male, 22 years of age, came to the Orthopedic Outpatient Department of the Massachusetts General Hospital in February, 1925, complaining of pain in the right knee. He first noticed a lump on the inner aspect of the right knee on arising on the morning of November 9, 1924, about 3 months previously. He could recall no injury to which to ascribe the condition. The knee was painful at intervals, especially at night. He had cramp-like pains in the calf of the leg and in the front of the thigh. A sharp pain in his knee came on when the leg was rotated. The knee was most painful on complete extension and acute flexion. The most comfortable position was about 85 degrees of flexion of the knee.

Examination showed a definite resilient tumor mass, the size of half an English walnut, visible and palpable on the inner aspect of the right knee in the joint line and extending downward onto the inner aspect of the tibia. It was covered by the internal lateral ligament and attached on its deep aspect to the structures upon which it rested. It was tender to pressure. The swelling, according to the patient, was no greater on admission than when first noticed 3 months before. The patient walked with a decided limp. The blood Wassermann was negative.

A diagnosis of cyst of the internal semilunar cartilage was made, the patient admitted to the ward, and operated upon on February 25, 1925. Through a curved transverse incision over the mass the internal lateral ligament was exposed. When the fibers of the lateral ligament were separated, the tumor mass pushed through the opening. The cyst seemed to arise from the semilunar cartilage and to have grown down onto the side of the tibia. In order to remove the cyst intact it was necessary to remove the internal semilunar cartilage. This cyst, much larger than either of the cysts removed from the external semilunar cartilage, was found to be filled with the same kind of reddish mucoid material (Fig. 4).

The patient made an uneventful recovery and when discharged from treatment on June 3, 1925,

Fig. 3. Photomicrograph of specimen from Case 2 shown in Figure 2.

Fig. 5. Photomicrograph of specimen from Case 3 shown in Figure 4.

the wound had healed nicely, there was no intra-articular or extra-articular swelling, there was a complete range of motion and no abnormal mobility.

The following is a report of the histological examination of the tissues by Dr. S. Burt Wolbach, Professor of Pathology, Harvard Medical School.

"There are three specimens submitted from different cases. They all show similar appearances and the same apparent sequences so that one description applies to the three.

"The largest cysts, including those of a millimeter in diameter upward, are surrounded by dense fibrous tissue of concentrically arranged cells and intercellular material so that the effect is almost that of a laminated wall. Occasionally on the inner surface of this wall there are flattened nuclei belonging to cells without demonstrable cytoplasm. The contention that these cells are endothelial (or mesothelial) might well be raised if the study of smaller cavities did not indicate a different origin.

"The larger cavities are situated toward the periphery of the cartilages; as one passes inward, smaller cavities are found, some of which are lined and in a few instances partially filled with a fibrin-like material. This fibrin-like material is undergoing avascular organization by cells derived from the surrounding fibrous tissue in the neighborhood. Toward the inner margin of the cartilages there is a profound change of the texture of the fibrocartilage giving an appearance of irregular areas slightly stained or not stained at all, traversed and surrounded by normal appearing, densely stained fibrous tissue of a character found in fibrocartilage. In but few places in any of the three specimens can cartilage, normal for fibrocartilage, be found. The appearances indicate that the first step in the sequences of cyst formation is a dissolution of the cartilage matrix and disappearance of the cartilage cells. In the specimen from Case 3, some of these areas contain deposits of amorphous calcium salts. In all three specimens one finds in this rarified and œdematous appearing tissue small cavities, most of which contain a deposit of fibrin-like material. There are evidences of reparative reaction on the part of fibroblasts in all three specimens, but most noticeable in that from Case 1, and here there is a striking avascular organization of degenerated areas. Clusters of cartilage cells indicate that chondroblasts are playing some part in this repair, but the general effect of the repair is to isolate, by organization, foci containing liquid and fibrinoid material. Evidence also of the coalescing of small cavities is present. At the peripheral border of the cartilage there seems to be an increase in vascularity as if there had been new capillary formation. There is no inflammatory reaction other than occasional lymphoid cells and the presence of mononuclear phagocytes containing hemosiderin pigment. Small arteries and veins are normal.

"I should answer your inquiries regarding specialized lining of the cysts in the negative. The interpretation of my brief report is that the cavities arise in foci of degeneration in the fibrocartilage taking origin in the matrix of cartilage, and it would seem that in some instances this should lead to the formation of calcified deposits demonstrable in gross, as is evidenced microscopically in Case 3. The ordinary sequence, however, in these semilunar cartilages seems to be the formation of cavities due to the accumulation of liquid, probably by osmosis. The character of the fibrinoid material should be investigated through appropriate staining methods. I suspect that it is not fibrin, but an atypical product of adjacent fibroblasts. It eventually becomes com-

pletely replaced by dense concentrically arranged fibrous tissue. I am quite certain that you can exclude a lymphatic or synovial origin for these cysts."

Taking the pathological report of Dr. Wolbach as a basis, it is reasonable to assume that the exciting cause of these cysts might be an injury, but such an assumption cannot explain the evident progressive degeneration of the cartilage over a period of months or even years after the injury.

Fisher (3) believed that the outer third of the semilunar cartilages derived their nourishment from blood vessels that entered the cartilage on the periphery. The inner two-thirds on the other hand derived its nourishment from the synovial fluid. His reason for this belief was based on his observation that in transverse tears of the semilunar cartilage, the outer third healed by dense fibrous tissue while the inner two-thirds failed to heal at all.

This power of repair on the part of the outer third of the semilunar cartilage might logically be explained by the better blood supply of that part of the cartilage or by the invasion of fibroblasts from the fibrous tissue present about the periphery of the cartilage. Moreover, the failure of the inner two-thirds of the cartilage to unite might be due to a feeble blood supply, lack of immobilization, the tendency of the torn ends to retract or to a combination of all three factors.

In all the cysts reported, the main cyst representing the most advanced state of the degenerative process was in the periphery of the cartilage which would support the belief that a serious interference with the blood supply of this region was the exciting cause of the degeneration. The observation of Dr. Wolbach in his report of the histological study of the three cases here reported that "toward the inner margin of the cartilage there is a profound change in the texture of the fibrocartilage giving an appearance of irregular areas slightly stained or not stained at all" would lend support for the belief that the semilunar cartilage was nourished almost if not entirely by the blood vessels which enter the cartilage at the periphery and that the inner part of the cartilage being deprived of its source of nourishment by the original injury or by the degenerative process on the periphery, also degenerated.

From the study of the cases here reported and a review of the cases previously reported, it is our belief that these cysts represent the end-result of a degenerative process caused by an interference with the blood supply of the cartilage in this region, the exciting cause of which is a non-lacerating injury.

The salient points about all the cases reported are:

1. The cysts are multilocular.
2. They have no endothelial lining. (Exception: Ollerenshaw's case.)
3. They are filled with a mucoid substance.
4. There is no evidence of inflammatory reaction about them.
5. The cysts have in all cases been located in the midportion of the semilunar cartilage on the external border.
6. A definite history of injury was present in almost half of the cases.
7. The cysts reach their maximum size quickly and then remain stationary.
8. Most of the patients were in the second decade of life.
9. Spontaneous recovery is unknown and recurrences have taken place in those cases in which the entire cartilage was not removed.
10. Pain is present on complete extension and on acute flexion of the knee.

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FRACTURES

A Brief Analysis of All the Fractures Treated at the Newell Clinic and Sanitarium During the Years 1920–1924, Inclusive[1]

By E. DUNBAR NEWELL, B.S., M.D., F.A.C.S., EARL R. CAMPBELL, B.S., M.D., and J. MARCH FRERE, M.D., Chattanooga, Tennessee

DURING the years 1920 to 1924 a total of 1,527 fractures were treated at the Newell Clinic and Sanitarium of Chattanooga, Tennessee. These cases may be divided as follows:

Fractures	Cases
Chest	99
Elbow	22
Femur	50
Bones of the foot	326
Bones of the hand	338
Bones of the head and face	90
Humerus	29
Knee, including patella	42
Leg, including both tibia and fibula	139
Bones of the pelvis	52
Scapula	21
Clavicle	29
Spine	33
Radius	182
Ulna	75

In 35 of these cases (which of course does not include the operations necessary for fractures of the skull) it was necessary to do open operations as follows:

Open operation	Cases
Clavicle	1
Humerus	2
Elbow	3
Femur	3
Radius and ulna	5
Tibia and fibula	6
Patella	6
Maxilla	4
For depressed zygomatic arch	5

The most impressive fact found by this review of our cases was that there was only one non-union in all of the 1,527 fractures and this was a fracture of the radius. In 1 tibia case it was necessary for the patient to wear a supporting brace for more than 2 years before the union became firm. But without any other treatment than an ambulatory brace to his leg, the union became firm and now he walks without a limp, has no pain, and there is no deformity. In another case of fractured tibia, firm union was delayed for 1 year and in several other cases of fractured tibia, firm union was delayed for 6 to 10 months. The treatment in all of these cases was an ambulatory splint after the first 2 months following the fracture. In no other bone in this series was there any marked delay in the normal time for firm union of the fracture.

There was 1 case of Volkmann's contracture in this series. The history of this case was as follows:

A boy, age 15, had fallen about 10 feet from a tree and landed on outstretched left hand, fracturing both radius and ulna in the upper third. The X-ray showed marked overriding of both fractures. There was much swelling of the entire forearm and circulation in the hand was poor. Under general anæsthesia the fractures were reduced and the forearm put up in anterior and posterior board splint well padded. The patient was put to bed in the hospital with an electric pad surrounding the splinted forearm. He was kept in bed in the hospital for 4 days under close observation. Before he left the hospital the bandages were removed, the forearm inspected, and the splints loosely reapplied. At this time the circulation in the hand and fingers was very good but there were numerous blebs over the forearm. We removed the dressings and gently massaged the soft parts every few days and often every day for several months. In spite of all this precaution the patient developed a serious Volkmann's contraction.

I believe now that if I had not reduced the fracture at once but waited a few days for the swelling to subside and then done a careful open operation, I would not have had this contraction.

The history of the only un-united case is briefly as follows:

A white man, age 39, had the right hand, forearm, and arm caught in a belt. The injury consisted in a transverse fracture of the right humerus in the middle third and an oblique fracture of the right ulna and radius 2½ and 3½ inches respectively from the wrist joint. Under general anæsthesia the fracture was reduced. Anterior and posterior moulded plaster splints were applied to the arm; and an anterior and posterior board splint was applied to the forearm. The bones of the humerus and of the

[1]Read before the Tennessee State Medical Association, Nashville, Tennessee, April 21, 22, and 23, 1925.

Fig. 1. Case 1. Transverse irregular fracture through medial third of left clavicle with marked displacement and overriding.

Fig. 2. Case 1. Medial third of left clavicle two weeks after reduction showing very good alignment and apposition of bones.

ulna united promptly. Four months after the fracture, roentgenograms of the radius showed much callus formation but there was non-union. All bones of the forearm showed atrophy. Five months later there was still no union of the radius, therefore a bone graft was placed. No infection followed this operation. Ten months from the date of the bone grafting all splints were removed but a leather brace was used as the graft did not grow, there was still non-union, and the bone graft was being gradually absorbed.

DIAGNOSIS

In all of these fractures the diagnosis was based on X-ray findings. In no instance did we depend on physical examination alone. We are firmly convinced that many fractures are overlooked even after the most painstaking physical examination if an X-ray picture is not made. On the contrary, many cases will be diagnosed as fracture when a physical examination and the history are depended upon without the aid of the roentgenogram. We regard the negative X-ray report in many cases just as valuable both to the patient and the surgeon as the positive finding. Many years ago the writer formulated the following

Fig. 3. Case 2. Transverse fracture through center of right patella with some separation of fragments.

Figs. 4 and 5. Case 2. Functional results 3 months after open operation.

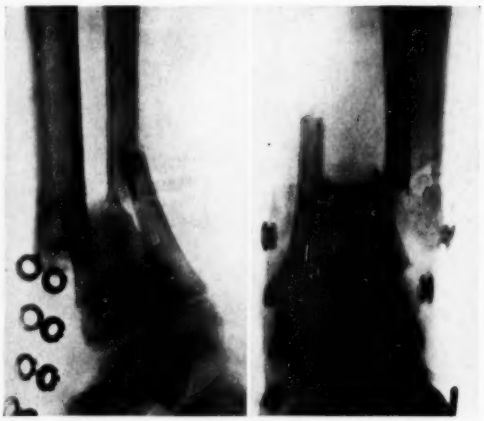

Fig. 6. Case 3. Transverse (compound) fracture of both distal thirds of the right tibia and fibula with displacement.

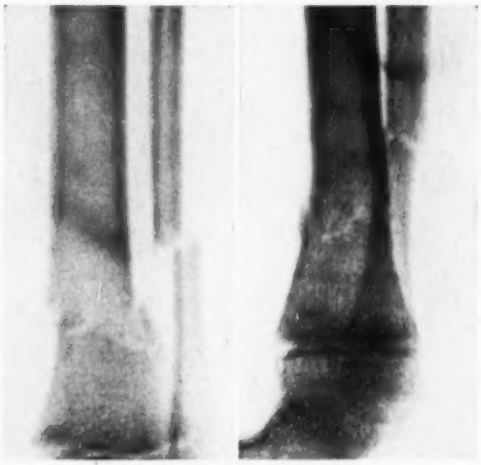

Fig. 7. Case 3. Results after reduction (open operation) without use of retention sutures or plates.

Fig. 8. Case 4. Showing flexion of patient's fingers when he appeared for treatment for Volkmann's contraction.

Fig. 10. Case 4. End-results showing complete extension of fingers.

rule which is rigidly carried out in our clinic: Whenever the blow or trauma has been sufficient to cause a fracture, an X-ray plate must be made whether or not the physical findings indicate fracture. On hundreds of occasions we have been justified in this practice and we never offer any apologies for the extra expense the patient or industry has to bear; for we know full well that if we did less the patient, industry, and the attending surgeon would all suffer thereby.

TREATMENT

We find that in this series of 1,527 fractures it was necessary in our opinion to do only 35 open operations. Open operation was used when we could not properly reduce the frac-

Fig. 9. Case 4. Roentgenogram of arm in cast following operation for shortening of both bones.

Fig. 11. Case 5. Transverse fracture of right radius and ulna showing angulation, overriding, and displacement of bones.

Fig. 12. Case 5. Three and a half months later showing results of reduction and callus formation without open operation.

ture or the fracture was badly compounded. By simply enlarging the opening by direct open manipulation the reduction could be made more accurately and with less trauma. With few exceptions we are bitterly opposed to the open operation for the reduction of fractures and the fact that we did only 35 open operations in 1,527 fracture cases proves our conservatism in this regard. We believe that the less skill, the less experience, the less patience the bone surgeon has, the more he is inclined to do the open operation for the

Fig. 13. Case 6. Roentgenogram taken after two attempts to reduce fractures.

Fig. 14. Case 6. Roentgenogram showing results after open operation.

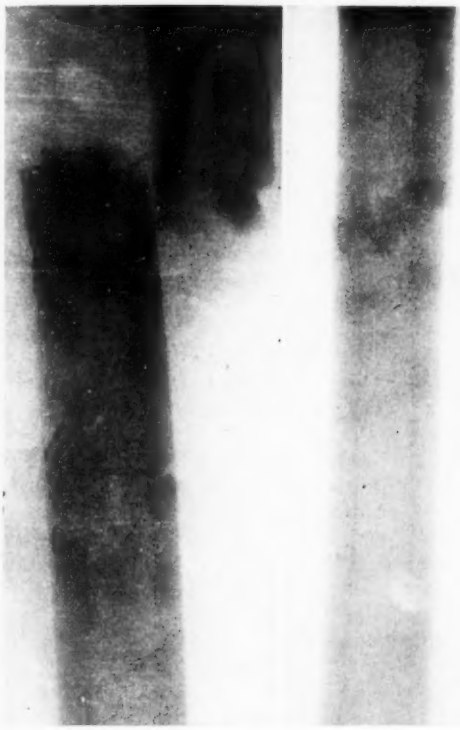

Fig. 15. Case 7. Transverse fracture of proximal third of right femur with displacement and overriding of the bones.

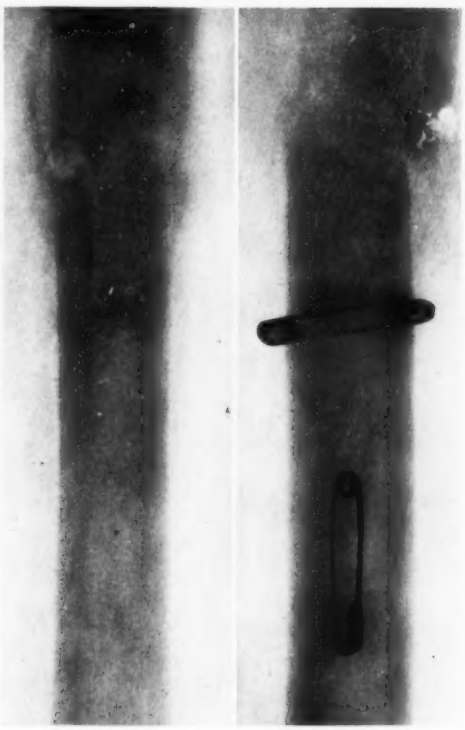

Fig. 16. One and a half months later showing results gotten with traction in a Thomas splint and Balkan frame after failure to reduce on Hawley table under anæsthesia.

reduction of fractures. Despite our general antagonism to the open operation for reduction and maintenance of fractures there are some fracture cases in which we always advise the open operation.

In the fractured patella we always operate unless there is some reason why we should not, because it has been our experience that we get better results from the open operation. When the fracture is caused by a direct blow on the patella and the ligaments are apparently not torn, then an open operation may not be necessary; but even in these cases when the fragments cannot be easily held in accurate apposition by position and splints we do the open operation. When the fracture is due to muscular violence we always do the open operation because in these cases the ligaments have been torn and unless they have been carefully sutured a normal knee joint cannot be expected.

In depressed fractures of the zygomatic arch, we have found that we get the most perfect results by the open reduction which is usually done under local anæsthesia.

In fractures of both bones of the forearm we have at times been unable to get satisfactory reduction and maintenance without an open operation on one or both bones. In these cases when repeated efforts at reduction have failed, we have found it far more satisfactory to do the open operation rather than to damage the soft parts further by renewed attempts at reduction and maintenance. In fractures of the bones of the forearm where the fragments are not easily held in place by position and splints, we believe the open operation is the method of choice. In certain

Fig. 17. Fig. 18.

Fig. 17. Case 8. Transverse fracture through middle of right femur showing anterior displacement of the superior bone with slight amount of overriding.

Fig. 18. Case 8. Results 15 months after open operation. (Note that all of bone plate has not been absorbed.)

mutilating fractures of the forearm when the forearm is greatly swollen, the circulation is poor, and further trauma from the manipulation for reduction of the fractures would endanger the life of the limb, the limb is placed in a hot pack for a few days and then the open operation is done. This same procedure is carried out in some of the mutilating fractures of the leg, foot, and ankle. Also, in oblique fractures of the tibia when maintenance is difficult we advise the open operation.

In fractures around the elbow when satisfactory reduction and maintenance cannot be obtained by manipulation and position, we believe that the open operation, especially in adults, offers the best functional and cosmetic results.

The method used in open operation is of the greatest importance. Some surgeons affect the "no touch" method with the ridiculous repeated resterilization of instruments as the important factor. The writer feels that the one factor in the success of all open operations is the gentle handling of tissues by clean cut dissections. In doing this the blood supply to the bone is interfered with as little as possible; the bone is never lifted from its bed by rough retraction, unless absolutely necessary; the periosteum is not disturbed; the attached fragments of bone are not removed; fractured ends are apposed without suturing or plating, if this is possible; and if this is not possible, the smallest number of retention sutures or appliances is used to hold the ends in apposition. I prefer silver or bronze wire as the suture material of choice for holding the fragments in apposition. When this technique has been carried out, infection, delayed union, or non-union need not be feared.

We do not dread compound fractures when the blood supply has not been greatly damaged, provided we see these cases a few hours after the injury. We shave the parts, do a débridement, use ether and iodine freely and suture the wounds without drainage or with just a rubber wick for 48 to 72 hours, apply retention splints, and do not expect infection or delayed union.

In all of our fractures of the femur in this series, with the exception of the three open operation cases, we used retraction with the Thomas splint and the Balkan frame. We have found that continuous traction is far more effective in reducing an overriding fractured femur than is a general anæsthetic and the Halley table. The greatest amount of traction must be put on during the first few days or until the overriding has been overcome and then the amount of the traction is lessened so that the ligaments of the knee joint are not injured. In fractures below the knee we use circular plaster casts or molded plaster splints with a foot piece.

In fracture of the humerus we use a Thomas splint while the patient is in bed and when he is up we use the plaster cast splint that holds the arm at right angles to the body. This splint is used only when it is difficult to hold the fractured ends in good apposition.

In fracture of the forearm we prefer the molded plaster splint or the anterior and posterior board splint well padded. However, the kind of splint is of little importance. Accurate reduction of these fractures of the fore-

arm is essential if we are to get 100 per cent functional and cosmetic results; whereas in fractures of the femur, if we have good alignment, we are content with 10 per cent apposition. In fact, we would not think of doing an open operation on the femur in a child even though nothing more than the edges were apposed, because in children bone defects of the femur have such a marvellous faculty of becoming corrected. In adults we are never content with less than 10 per cent approximation but in only 3 of 50 cases has it been necessary to do more than to use continuous traction with properly placed pads to get this amount of approximation.

Our fractures are inspected often, splints being removed and soft parts massaged as we believe this prevents non-union by stimulating the circulation in the limb, prevents pressure injury to the soft parts, prevents atrophy of muscles, and gives an opportunity for early passive motion in the joints.

DEPARTMENT OF TECHNIQUE

AN OPERATION FOR "DANGLE FOOT"[1]

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ORDINARY operative methods for the treatment of flail foot had, in our experience, been unsatisfactory, and when I suggested to Dr. Mackenzie that the ankle could be fixed by making osseous ligaments between the tibia and fibula above and the astragalus and os calcis below, he agreed that the method should be tried. The suggestion was based upon my experience during the war with rebellious ununited fractures. When these were treated with osteoperiosteal grafts, osteogenesis was stimulated to such an extent that large masses of callus resulted and union of the fracture followed.

The operation we have devised is simple, and in the hands of orthopedic surgeons is capable of wide extension if the principles on which it is based are applied to suitable cases.

The present communication refers to the first 3 cases operated upon, in which sufficient time has elapsed to prove that the fixation resulting from the operation is not just temporary. All of them were treated in the surgical annex of the Crippled Children's Home at Gosforth.

Case 1. A boy, J. J., aged 10½ years, was admitted for right "dropped foot," the result of infantile paralysis. There were no movements of the ankle joint and but faint voluntary flexion of the toes.

Operation was performed February 22, 1921, on the right ankle, under general anæsthesia. The whole leg was elevated to a right angle with the body, and a broad thin India rubber bandage was wound round the thigh to act as a tourniquet. This was the method adopted in all the cases and in all the tourniquet was removed after the completion of the first stage of the operation, so that these details require no further mention.

The patient was turned over, face downward, and a vertical incision 4 inches long was made over the center of the back of the leg, extending upward from the back of the heel. The tendo achillis was exposed by reflecting the skin on either side, and was cut across. The lower end of the tibia and fibula and the upper surface of the os calcis were exposed between the flexor longus hallucis on the outer side, and the tibialis posticus on the inner. The periosteum covering these bones was incised and with a chisel (curved on the flat) and a mallet, the periosteum with a thin layer of underlying bone was reflected from each for about an inch leaving four raw bony surfaces—one over the back of the tibial epiphysis, one over the fibular epiphysis, a third over the inner, and the fourth over the outer surface of the os calcis. This wound was covered up and compressed under a pad of gauze (Stage 1).

The leg was acutely flexed at the knee, and the foot laid upon towels resting on the thigh. A long incision was made over the front of the leg, convexity forward over the extensor muscles and a flap was reflected over the antero-internal surface of the tibia with its base outlined deeply by the internal saphenous vein. Incisions were made, 4 inches long, dividing the periosteum over the crest of the tibia in front and the lateral margin of the bone behind. These were joined by transverse cuts above and below, outlining the area to be removed for the graft. With a chisel and mallet this was separated, leaving chips and particles of bone adhering to the under surface of the periosteum. This wound was covered up, and the leg was extended to its original position, the first wound opened up, and the graft cut into two equal parts with a strong pair of scissors. One was laid down with its bony surface on the raw bone surfaces of the fibula and outer surface of the os calcis on the outer side, the other on the tibia above to the os calcis below on the inner side. The grafts were fixed in position by interrupted sutures of fine catgut tied with forceps (not fingers) attaching the graft to the detached periosteum of the bones above and below the ankle. The divided ends of the tendo achillis were approximated by a mattress suture of thick catgut, and the skin wounds closed.

Case 2. J.D., was 11½ years of age on admission to the Home for infantile paralysis. His left foot was flail. There were no voluntary movements. The left leg measured 23 inches, the right 25 inches.

Operation was performed October 11, 1921, with preliminary preparations as in the former case.

A J shaped incision was made over the inner side of the leg and foot, the vertical portion running parallel with and half an inch behind the posterior edge of the tibia, the horizontal arm extending forward over the os calcis at the junction of its middle and lower third. A flap of skin and subcutaneous tissue was reflected forward and an incision made behind and below the tendon of the tibialis anticus

[1] On June 20, 1925, since this paper was written, the Cripples' Home was honored by a visit from Dr. Charles Mayo and members of the Interstate Post Graduate Assembly of America. Hamilton Drummond, whose tragic death occurred a week later, first operated upon 2 cases of "dangle foot," performing the operation described in this paper. Drs. Morison and Mackenzie then demonstrated cases in the wards in which the ankle, the knee, and the spine had been fixed by osteoperiosteal grafts. They have now sufficient experience of this method to advise it with confidence in cases requiring bony fixation.

Figs. 1 and 2. Case 1. Before operation and after operation.

between it and the tibialis posticus on to and through the periosteal covering of the astragalus and os calcis. A chisel, slightly curved on the flat, was introduced through this incision down to the bone and with a series of mallet taps, a raw bony area, about 1 inch long by ¾ inch wide, was made by chipping back the periosteum and a thin under-

Fig. 3. Case 1. After operation.

Fig. 4. Case 1. Six months after operation.

lying area of bone. The tibialis posticus and flexor longus digitorum and the neurovascular bundle overlay this periosteal flap and were safely displaced backward by the underlying chisel. The periosteum covering the lower epiphysis of the tibia was divided vertically and separated by the chisel on each side, leaving the bone raw and chips of it adhering to the separated periosteum on either side. This wound was now covered up by the skin flap and gauze, and a J shaped incision was made on the outer side behind the fibula and over the os calcis, as on the inner. The periosteum of the os calcis was divided in front of the peronei tendons, and with the chisel a similar denudation was made as on the inner side. The periosteum covering the lower epiphysis of the fibula was next divided, and osteoperiosteal flaps were reflected to each side. The two sides of the ankle were now ready for the reception of the grafts, the wounds were covered up, and the tourniquet removed. Osteoperiosteal grafts from the antero-internal surface of the tibia were obtained, as described in the previous case, and placed in position, without sutures, the outer reaching from the fibula to the os calcis, the inner from tibia to astragalus and os calcis, and the wounds were closed.

Case 3. Ethel W., aged 9, was admitted to the Home on September 9, 1919, with infantile paralysis affecting both legs, a bad paralytic scoliosis, a dislocated right hip. Her right foot was flail.

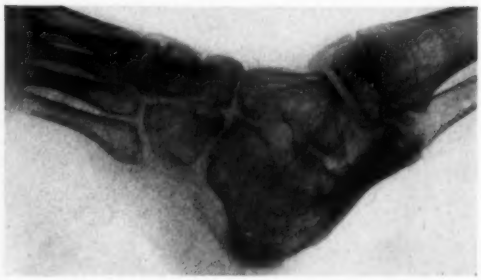


Fig. 5. Case 1. Three years and 10 months after operation.

Figs. 6 and 7. Case 2. Before, and 3 years after operation.

Operation, November 28, 1921, was done on her right foot exactly as described for Case 1, so that details are unnecessary.

The photographs before and after operation and the X-ray pictures show that the object of the operations have been fully realized. All of these patients have firmly fixed ankle joints and their feet are now capable of serving a useful purpose.

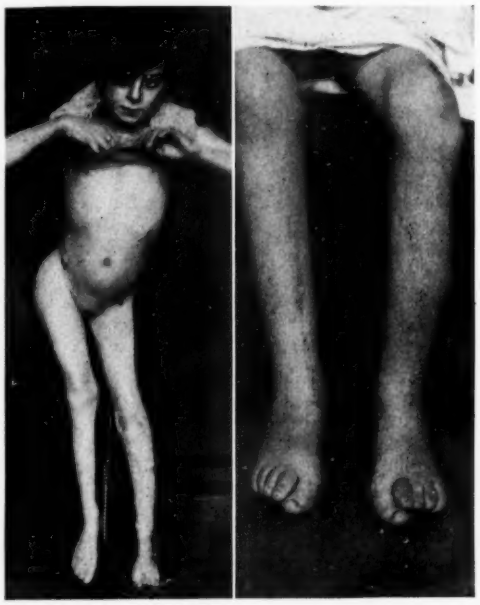
It will be noted that in each case there is swelling about the ankle joint. Though the X-ray does not clearly show this, it is due to new bone formation, judged by its hard consistency on palpation.

These operations, though easy, require attention to every detail if success is to be assured, so we make no excuse for describing our methods.

The skin covering the limb to be operated upon is prepared the night before in the ordinary way, covered with sterile gauze and a bandage, and these are taken off on the operating table after the tourniquet has been applied. The skin is then mopped with Harrington's solution for 2 minutes, and this is wiped away with spirit. The sterilized instruments, lying in 1 in 20 carbolic solution have hot water poured over them to dilute the carbolic to 1 in 60. Immediately before use the instruments are wiped dry with sterile gauze. The skin involved in the incisions is transversely scratched to allow of accurate suturing at the end of the operation. Only prepared instruments and sterile mops wrung out of warm saline are allowed to touch the wounds, no fingers, gloved or otherwise, being allowed. As soon as the osteoperiosteal flaps are separated at each end they are

Fig. 8. Case 2. Three years after operation.

Fig. 9. Case 2. Roentgenogram 3 years after operation.



Figs. 10 and 11. Case 3. Before operation (1921), and after operation (1925).

caught by the four corners in four pairs of fine toothed catch forceps,[1] two above and two below.

If the graft is cut in two, eight pairs are required. The bed for the graft is exposed by holding the edges of the divided periosteum apart with catch forceps, showing the raw bone area on to which the graft has to be laid. The reasons for this are: (1) to prevent the grafts from curling up or folding over and to keep them spread out ready for use; and (2) to keep them from falling when detached. Bone grafts have been known after their separation to find their way on to the floor and it is well to make such a calamity impossible!

The tourniquet is removed at the end of the first stage, because these patients all have cold limbs to which the blood supply is defective, and damage from too long application of the constrictor is more likely to happen to theirs than to normal limbs. Hæmorrhage has not occurred in

[1] These forceps now pass by a variety of names, sometimes those of distinguished surgeons, but in Newcastle they are always described as catch forceps. The first were made to the order of one of us (Morison) by Archibald Young, surgical instrument maker of Edinburgh, before 1880, and their many uses were frequently demonstrated to visiting surgeons in Newcastle Infirmary, but they never "caught on" till about 15 years ago, when they were introduced from France. Two varieties, one with three teeth and the other with five, were the original order, and they have not been improved upon.

Fig. 12. Case 3. Three years after operation (February 12, 1924).

any of our cases and the wound is usually sufficiently dry before the grafts are in position. The grafts should be lifted directly off the tibia and placed without avoidable loss of time in their proper places. If spread out and flattened they lie in position and sutures are only an unnecessary complication. The skin wounds, after the skin has been mopped all round with spirit, are closed with interrupted sutures of catgut and dressed with sterile gauze, on the outside of which powdered boracic acid is sprinkled from a flour dredger. Outside of this comes a thick layer of cotton-wool, two lateral gooch splints reaching from the tibial condyles above to the sole of the foot below, fixed by an ordinary bandage. At the lower end the foot and ankle are fixed by a spat of plaster of Paris, above by a broad garter of plaster of Paris, and the foot and leg are hung in a cradle.

In all of our cases the dressing has not been removed for a month; the wounds were then all dry and healed and the catgut was absorbed, the knots lying on the dressing. After washing with spirit the leg has been put into plaster of Paris for another 6 weeks.

Whether the posterior or lateral operation is to be preferred we cannot yet decide, as both have given equally good results. One advantage of the posterior incision is that only a single wound has to be made for the grafts.

A SIMPLE METHOD FOR CORRECTION OF DEFORMITY IN BONY ANKYLOSIS OF THE HIP JOINT[1]

By LeROY C. ABBOTT, M.D., F.A.C.S., and FRED A. JOSTES, M.D., St. Louis, Missouri

THE treatment generally indicated in ankylosis of the hip joint with deformity is correction of the deformity by osteotomy of the femur with immediate realignment and fixation of the limb in a good functional position for weight bearing. The simplest and the most frequently employed type of osteotomy consists of a transverse section of the bone just below the level of the trochanters. The objection to its use, however, is that in severe deformities, after the osteotomy is completed, the bone ends frequently slip by when the deformity is corrected. This may lead either to non-union or union with shortening; in either case the result is bad.

To overcome this difficulty various types of osteotomy have been devised, the best known of which are the cuneiform osteotomy and the curved osteotomy of Brackett. The former consists of the removal of a wedge of bone with its base facing in a direction varying with the character of the deformity present. In the latter the section of the bone is curved and correction of the deformity is obtained by rotation, the convexity of the lower fragment turning within the concavity of the upper. Slipping of the bone ends is prevented by the shelving edges of the upper fragment. Neither of these methods, however, constitutes an absolute safeguard against displacement of the fragments; moreover, in certain deformities they have not proved suitable. If the hip is ankylosed in a position of extreme abduction, flexion, and external rotation, it is often impossible to plan either a cuneiform or curved osteotomy with any reasonable assurance that the component parts of the deformity will be corrected. Even if the plan seems feasible its execution is attended by serious technical difficulties, and because of the marked contracture of the soft parts immediate correction of the deformity is almost certain to be followed by a displacement and overriding of the fragments. It was just such a deformity in a young lad admitted to the Shriners' Hospital for Crippled Children which lead to the development of the method of treatment to be described.

The method is based on the principle of treatment of mal-united fractures which has been emphasized by Sir Robert Jones (1, 2). He has shown, for example, that in recent mal-union of the femur, correction of angulation can be secured by gradual pressure over the site of fracture and by extension of the leg on a Thomas splint. In certain cases manipulation under anæsthesia followed by the application of strong traction may be necessary. One of us (L. C. A.) has combined manipulation and caliper extension in a

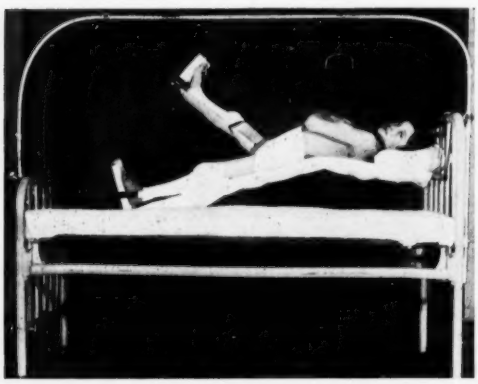


Fig. 1. Illustrating the method of securing fixation after osteotomy of the femur for correction of flexion and abduction deformity of the right hip. The position of deformity is maintained by fixing the lower end of the Thomas splint to a long tubal arm until callus is formed. The adjustable socket into which the tubal arm fits permits of a gradual change in the position of the splint until the deformity is corrected.

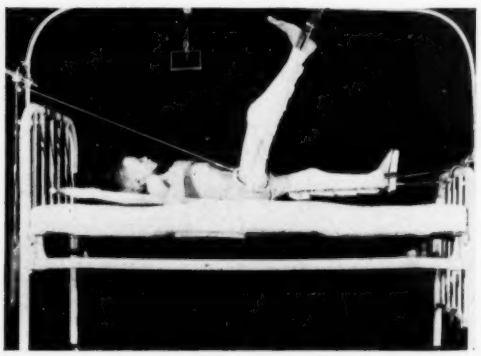


Fig. 2. Illustrating the method of fixing the pelvis in correction of flexion deformity of the left hip. Traction is applied to the left leg while the right is held on a Thomas splint with the hip flexed and the knee extended. In this position the taut hamstrings prevent hyperextension of the spine.

[1] From the Shriners' Hospital for Crippled Children, St. Louis, Missouri.

group of mal-united fractures of the femur. The details of the method of application and the results secured have been published in a previous article (3). The point of fundamental importance to the surgeon, however, is that in the early stages of the mal-united fracture the bone ends are surrounded by a soft callus. The plastic character of the callus permits correction of the deformity by a gradual molding without serious risk of displacing the fragments.

The practical application of this principle in the correction of deformity of the hip with bony ankylosis is realized in the following manner:

A subtrochanteric osteotomy of the femur is done and the limb is fixed in the position of deformity by applying a Thomas splint with traction. When callus has surrounded the bone ends gradual correction of the deformity is obtained by changing the position of the limb. For example, in abduction deformity the leg is gradually adducted until it becomes nearly parallel to its fellow. With each change in position a bending of the callus occurs. When the final position of correction is secured we have produced a definite angulation at the site of osteotomy. We have obtained correction of the deformity, therefore, by creating a mal-united fracture of the femur but without any displacement of the fragments.

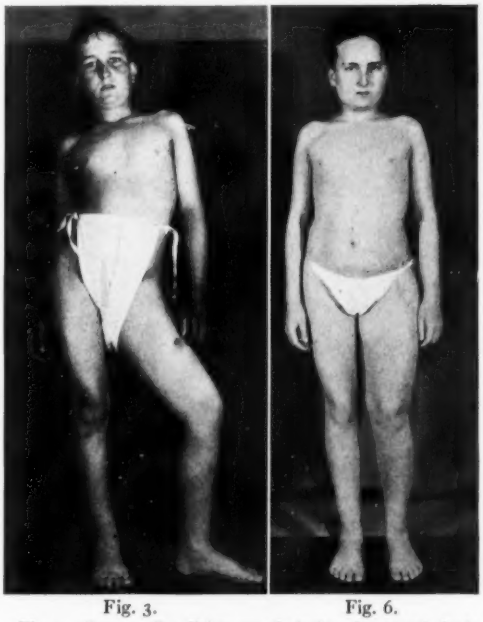


Fig. 3. Fig. 6.

Fig. 3. Case 1. Condition on admission. Bony ankylosis with deformity of abduction, flexion, and external rotation.
Fig. 6. Case 1. Complete correction of deformity.

Fig. 4. Fig. 5.

Figs. 4 and 5. Roentgenograms showing extreme abduction deformity with bony ankylosis and solid union of fragments after correction of deformity.

Fig. 7.

Fig. 9.

Fig. 7. Case 2. Condition on admission. Abduction, flexion, and external rotation of the right hip. Patient walks with only the toes touching the ground.

Fig. 9. Case 2. Correction of deformity obtained by osteotomy of the femur and a gradual bending of the callus.

The desired position for function is maintained until consolidation of the callus has taken place. The description of the method is best given under the following headings:

1. Subtrochanteric osteotomy of the femur.
2. Fixation of the leg until the fragments are imbedded in the callus.
3. Gradual correction of the deformity.
4. Protected weight bearing.

Subtrochanteric osteotomy of the femur. If the deformity is one of abduction and external rotation a vertical incision, 4 to 5 inches in length, is made on the anterior aspect of the thigh beginning just below the anterior superior spine of the ilium. The deep fascia is divided in the line of the skin incision and the interval between the tensor fasciæ femoris and sartorius is seen. When these two muscles are separated, the tendinous portion of the rectus is exposed and on its lateral aspect is the upper part of the vastus lateralis. At this stage it is usually necessary to ligate the transverse branch of the lateral circumflex artery. The femur is exposed by retracting the rectus muscle inward and the vastus lateralis muscle outward. A vertical incision is made through the periosteum and a transverse osteotomy is performed. The periosteum and deep structures are approximated by interrupted catgut sutures while the skin is closed with silk. The limb is then fixed in its position of deformity by applying a Thomas splint with adhesive traction.

In flexion and adduction deformities we have made the incision on the posterior external aspect of the trochanter and upper femur. A part of the fibrous expansion of the gluteus maximus is divided with exposure of the vastus lateralis. This muscle is divided in the line of its fibers and the periosteum is incised vertically. A transverse subtrochanteric osteotomy is then performed and the wound closed in the manner described in the preceding paragraphs.

Fixation of the leg until the fragments are imbedded in callus. The patient is placed on a Bradford frame, the upper end of which is suspended to the head of the bed by heavy leather straps. This arrangement permits use of the bed pan without changing the position of the patient. In our first case we secured immobilization of the leg by pillows and sand bags, but more recently we have made use of an overhead bed frame. Our bed frame is a modification of the frame designed by Robert Morison of the Royal Infirmary, Edinburgh. It is constructed of gas pipe with upper and lower uprights which clamp on the ends of the bed. They are joined by a horizontal bar. Adjustable sockets into which can be fitted tubal arms of various lengths allow for fixation of the limb in any position desired. The frame is portable and can be easily and quickly adjusted. The leg is immobilized in the position of the deformity by maintaining traction and fixing the lower end of the Thomas splint to a horizontal tubal arm (Fig. 1). At the end of the fourth or fifth week the roentgenogram will usually show abundant callus surrounding the bone ends. We are now ready to begin the correction of the deformity.

Gradual correction of the deformity. The correction of the deformity is secured by a gradual change in the position of the leg. Figure 1 shows the leg held in abduction and flexion. In such a case the treatment is begun by turning the tubal arm downward and inward. Each day the lower end of the Thomas splint is brought a little nearer to the midline. With each successive change there is a bend in the callus surrounding the fragments. This bend is not acute but grad-

Fig. 8.

Fig. 10.

Fig. 8. Case 2. Right angle abduction of the hip with incomplete ankylosis.

Fig. 10. Case 2. Roentgenogram showing how correction of deformity was secured by movement at the hip joint and at the site of osteotomy. The fragments are solidly united.

ual, and the roentgenograms of the completed cases show a very smooth and rounded curve at the site of the osteotomy. The time required for correction of the deformity in the average case is about 4 weeks. When this position is obtained the limb is fixed until clinical examination and the roentgenograms indicate consolidation of the callus. The apparatus is then removed and the patient allowed to move about in bed.

Control of the pelvis during the period of correction is absolutely essential. It can be secured by the application of traction to the opposite leg. In correcting the deformity of abduction, traction is applied with the opposite leg held in line with the trunk; in adduction, with the opposite leg held in full abduction. Fixation of the pelvis and lumbar spine during the correction of flexion deformity is obtained by holding the sound limb on a Thomas splint with right angle flexion of the hip and complete extension of the knee. In this position the hamstrings are held taut and arching of the lumbar spine, false correction, is entirely prevented (Fig. 2).

This method of fixation with the lumbar spine suggested itself to us through the use of the Thomas test for hip flexion. To ascertain accurately the amount of flexion in pathological conditions of the hip joint, Thomas prevented hyperextension of the lumbar spine by holding the flexed thigh against the abdomen. It occurred to us that the same object could be attained during the correction of flexion deformity of the hip by holding the opposite thigh at right angles to the trunk with the knee extended. This method is especially useful for correction of flexion contracture of the hip in cases of infantile paralysis. We have also found it of great value in completing extension of the hip after fasciotomy of the hip flexors. The fixation is far superior to that obtained by either a plaster jacket or strapping the pelvis to a Bradford frame. We have not observed this method in other clinics, nor have we seen it in the literature.

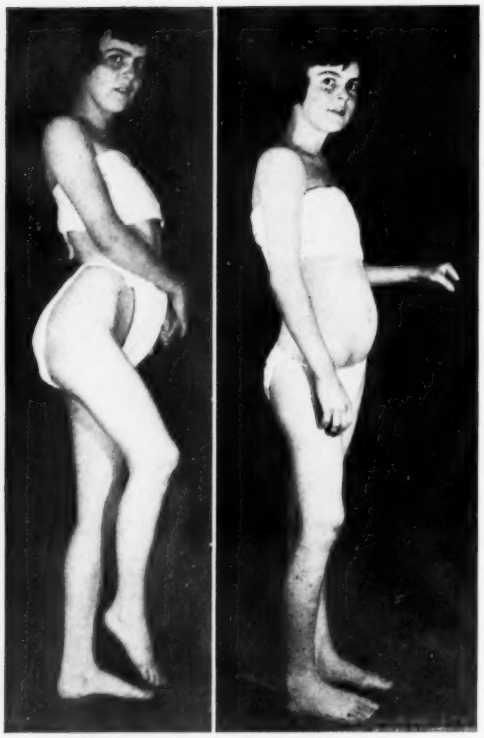


Fig. 11. Fig. 14.

Fig. 11. Case 3. Condition on admission. Flexion, abduction, and internal rotation of the right hip.

Fig. 14. Case 3. Position of correction secured by osteotomy and gradual molding of the callus.

During the period of consolidation of the callus, the thigh and calf are massaged and the quadriceps muscle is exercised. After the apparatus has been removed, exercises of the knee are begun. There will be some stiffening of this joint incident to immobilization, but this is readily overcome by a competent physiotherapist.

Protected weight bearing. As the tests for consolidation of callus are not absolute, we have found it a good practice to use a protective weight-bearing appliance when the patient becomes ambulatory. For this purpose the Thomas walking caliper splint is both simple and practical. It is worn for several months and gradually discarded. It is finally removed when careful and repeated observation shows no tendency to any increase in the deformity at the site of osteotomy.

The advantages of this method of correcting deformities of the hip joint are that it renders unnecessary the use of complicated osteotomies. A simple operation is substituted for a difficult one. Through its use the contracted soft parts are gradually stretched so that there is little risk of displacement of the fragments. In the ordinary osteotomy the limb is fixed postoperatively in a plaster of Paris spica and it is very difficult to determine whether the desired position of correction has been obtained without resorting to frequent changes of plaster. With this method the limb is free for inspection throughout the treatment and the necessary changes can readily be made.

RESULTS

Four cases have been treated by this method. The first 3 had deformities of abduction, flexion, and external rotation. The type of deformity present is shown in Figures 3 and 4. One patient had a quiescent tuberculosis of the hip with a deformity of adduction, flexion, and internal rotation. Correction of the deformity was obtained and there was great functional improvement in every case.

The difficulties of determining the presence of bony ankylosis of the hip joint was forcibly demonstrated by Case 2. An incomplete bony ankylosis was suspected after a study of the roentgenograms, but a careful examination under anæsthesia failed to detect motion. A subtrochanteric osteotomy was performed and the roentgenograms (Figs. 8 and 10) show that the greatest amount of correction was secured through motion of the hip joint. In all probability, correction of the deformity could have been secured without osteotomy. In the fourth case there was some displacement of the fragments which was probably brought about by inadequate fixation of the limb while waiting for callus to form. In deformities in which fixation is difficult it would seem desirable to apply a plaster of Paris spica and remove it by bivalving before operation. Immobilization could then be obtained by its reapplication following operation.

The results obtained in these 4 patients were excellent and we feel justified in advocating the method as a substitute for the ordinary osteotomy. It will be found extremely useful in correction of complicated deformities of the hip joint with bony ankylosis.

CONCLUSIONS

1. Correction of the deformity in ankylosis of the hip joint is generally secured by a subtrochanteric osteotomy of the femur. In cases with marked deformity, however, there is a great risk of displacement and overriding of the fragments.

Fig. 12.

Fig. 13.

Fig. 15.

Fig. 12. Case 3. Roentgenogram showing almost complete destruction of the head and neck of the femur. Bony ankylosis is questionable.

Fig. 13. Case 3. After osteotomy of the femur, showing some displacement of the fragments probably due to inadequate immobilization following operation.

Fig. 15. Case 3. Final result. Union of the fragments with consolidation of the callus.

2. The risk of displacing the fragments is minimized by using the cuneiform and curved types of osteotomy.

3. The objections to these methods are that in certain types of deformity the execution is extremely difficult and often impossible. They do not constitute an absolute safeguard against slipping of the fragments.

4. The method described, which combines a simple transverse osteotomy with a subsequent molding of the callus to secure correction of the deformity, has been found by us to be very simple and entirely satisfactory.

CASE 1. W. H., a male, age 13, was admitted to the Shriners' Hospital for Crippled Children, May 23, 1924, complaining of stiffness and deformity of the left hip. In September, 1922, the patient jumped from a rafter and that evening he complained of pain in the left hip. Three days later he was confined to bed with high fever and the left hip began to swell. He was taken to a hospital where a diagnosis of tuberculosis of the left hip was made and weight and pulley traction was applied. During the next 6 weeks the pain continued and the swelling increased until the left hip was twice the size of the normal one. From this time on, the swelling gradually decreased. The traction was removed at the end of the tenth week and the hip gradually drew upward. In March, 1923, he was discharged from the hospital. The hip remained swollen and deformed. At the present time there is no pain, but the patient's gait is very awkward because of the deformity.

Physical examination. The patient is a well nourished boy. The general examination is essentially negative. The left hip is held in a position of extreme abduction, flexion, and external rotation. There is a marked thickening of the soft tissues in the groin, anterior surface of the upper thigh, and over the crest of the ilium. The entire left thigh is much larger than the right. There is no motion of the hip in any direction. In walking the pelvis is tilted downward on the affected side with a compensatory curvature of the lumbar spine. The gait is very slow and awkward (Fig. 3).

Roentgen-ray examination, May 23, 1924, showed a deformity of 90 degrees abduction and there is solid bony ankylosis. The diagnosis was old osteomyelitis of the head and neck of the femur with involvement of the joint, and bony ankylosis (Fig. 4).

At operation, May 29, 1924, an incision was made on the anterior aspect of the thigh in the manner described above. Considerable difficulty was experienced in exposing the femur because of the mass of scar tissue encountered. The bleeding from the scar tissue was profuse. A transverse osteotomy of the femur was done and because of the possibility of lighting up the old infection the wound was packed open with gauze saturated with acriflavine. Counter drainage was established by a stab wound in the buttock. A Thomas splint was applied and immobilization secured by pillows and sand bags.

Fig. 19.

Fig. 16.

Fig. 16. Case 4. Condition on admission. A marked deformity of abduction and flexion.

Fig. 19. Case 4. Final result. Complete correction of the deformity.

June 5, 1924. The postoperative convalescence was uneventful. Dressing of the wound showed it to be clean. Immobilization of the leg was continued.

June 17, 1924, the roentgen-ray examination showed abundant callus formation with no displacement of the fragments. During the next 3 weeks the deformity was corrected by gradually adducting and internally rotating the leg. June 28, 1924, the roentgen-rays showed a bending of the callus and no displacement of the fragments. Immobilization was continued until August 23 when the roentgenograms indicated consolidation of the callus (Fig. 5). The wound is completely healed. A Thomas walking caliper splint was applied and worn until the first week in October. It was then gradually discarded and the patient was discharged from the hospital October 29.

January 19, 1925, the patient returned to the hospital for observation and examination showed about 20 degrees of abduction and 20 degrees of flexion. There is no pain and he walks with only a slight limp. The functional result is excellent (Fig. 6).

Case 2. A. P., a male, age 7, was admitted to the Shriners' Hospital for Crippled Children, August 19, 1924, complaining of deformity and stiffness of the right hip. In February, 1924, the patient fell down a flight of steps injuring the right hip. For the next 2 weeks there was pain in the hip and fever. An abscess formed and was lanced. Drainage continued for about 3 weeks when the wounds were healed. Weight and pulley traction were used during the acute stage. When these were removed the leg was drawn upward until it reached its present position of deformity. Now he walks with the right leg held in wide abduction and with only the toes touching the ground.

Physical examination. The patient is a fairly well developed boy with the right hip held in a position of extreme abduction, flexion, and external rotation. In walking, only the toes on the right side touch the ground and the gait is very awkward. No motion can be detected in any direction. There is no pain or sensitiveness of the joint (Fig. 7).

Roentgen-ray examination, August 19, 1924, showed the thigh abducted 90 degrees. There is destruction of the joint cartilage. The diagnosis is suppurative arthritis of the right hip joint and incomplete ankylosis (Fig. 8).

At operation, August 25, 1924, a subtrochanteric osteotomy was done through the usual anterior incision. The leg was held in the position of deformity by traction on a Thomas splint. This was maintained for 15 days.

September 8, 1924, correction of the deformity was begun by gradual adduction of the leg. September 23, 1924, roentgen-ray examination showed correction of the deformity with the fragment held in a mass of callus. The leg was then immobilized for 6 weeks.

Roentgen-ray examination, October 30, 1924, showed complete correction of the deformity with union of the fragments. It was interesting to note here that the deformity was corrected by movement both of the hip joint and at the site of osteotomy. It seems likely that correction of the deformity could have been secured without osteotomy. Knowing that there was not complete ankylosis of the joint a short plaster of Paris spica was applied and the patient allowed to walk. January 1, 1925, he was discharged from the hospital wearing the plaster spica.

April 1, 1925, the spica was removed and the examination showed the hip held in slight abduction and slight flexion. He walked with only a slight limp (Fig. 9). The roentgen-ray examination (Fig. 10) showed correction of the deformity with solid union of the fragments. A new spica was applied and bivalved. The patient was to return in 6 months.

July 10, 1925, a letter from the family doctor stated that 2 months ago the patient fell and sustained a supracondylar fracture of the left femur. This has healed in good alignment and with full length. The position of the hip is excellent and he walks with only a slight limp.

Case 3. V. G., a female, age 15, was admitted to the Shriners' Hospital for Crippled Children, September 19, 1924, complaining of stiffness and deformity of the right hip. At 18 months of age the patient had difficulty in walking and the hip seemed stiff. There was pain in the right knee and fever at irregular intervals. The hip gradually became deformed, but at 3 years of age the child began to walk. She has not been under the care of a physician, and at the present time, 13 years after the onset, there is an extreme deformity of the hip which makes walking very difficult.

Physical examination. The general examination is negative. The right hip is fixed in a position of 70 degrees flexion and 15 degrees adduction (Fig. 11). There is about 3 inches of shortening, the major portion of which is confined to the femur. No motion is present in the hip in any direction. The gait is extremely awkward due to the very marked deformity and shortening.

Roentgen-ray examination, September 9, 1924, showed an old destructive process of the right hip. The head and most of the neck of the femur were missing. The diagno-

Fig. 17.

Fig. 17. Case 4. Roentgenogram showing fusion of head of the femur and acetabulum.

Fig. 18.

Fig. 18. Case 4. Roentgenogram after osteotomy of the femur and gradual molding of the callus.

sis was tuberculosis, and probably incomplete ankylosis (Fig. 12).

At operation, September 18, 1924, through a posterolateral incision, a cuneiform osteotomy was done; for at the outset it was decided to try to correct the deformity in this manner. The marked contracture of the soft parts prevented this correction, so the leg was immobilized by means of traction on a Thomas splint.

September 28, 1924, the day after operation, the patient had a high fever which continued for a week, after which the temperature gradually returned to normal. This was probably due to a tuberculin reaction from the old tuberculous joint, as the wound healed by first intention.

October 10, 1924, a gradual correction of the deformity was begun and final position of correction was secured in about 3 weeks.

Roentgen-ray examination, October 21, 1924, showed some displacement of the fragments (Fig. 13). This was possibly due to inadequate immobilization of the limb while waiting for callus to form. In the deformity of flexion and adduction it would seem best to fix the limb postoperatively in a plaster of Paris spica. Roentgen-ray examination, November 21, 1924, showed correction of the deformity and consolidation of the callus. The patient remained in bed until December 10, 1924, when a plaster of Paris spica was applied. She was then allowed to walk.

January 9, 1925, the patient was discharged wearing a plaster of Paris spica.

March 18, 1925, she returned walking quite well; the spica was removed. The position of the hip was satisfactory except that there seemed to be a slight increase of flexion (Fig. 14).

Roentgen-ray examination, March 18, 1925, showed complete correction of the deformity with union of the fragments (Fig. 15). A new spica was applied and the patient was to return in 3 months. In all probability the hip joint was not solidly ankylosed and fixation should have been continued for a year or more.

July 22, 1925, the patient returned for examination. She walked very well and there was no pain at any time. No motion could be detected and there was no sensitiveness. The functional result is excellent.

CASE 4. J. W., a male, age 16, was admitted to the Shriners' Hospital for Crippled Children, October 14, 1924, complaining of stiffness and deformity of the left hip. At the age of 6 years the patient had pain in the left hip which necessitated treatment in a hospital. Traction was applied and this was followed by fixation in a plaster of Paris spica. No further history could be obtained as patient lived in a Masonic Home and his parents were dead. At examination he walked with a very marked limp because of the deformity of the left hip.

Physical examination. The patient is a very well developed and nourished boy. In standing there is a very marked lumbar lordosis with 90 degrees of flexion of the left hip and about 35 degrees of abduction (Fig. 19). There is no motion of the joint in any direction and no pain is elicited on a forcible attempt to move the joint.

Roentgen-ray examination (Fig. 17) showed fusion of the head of the femur and acetabulum.

At operation October 20, 1924, through an anterior incision, a subtrochanteric osteotomy was done in the usual manner. A Thomas splint and traction was applied holding the leg in the position of deformity. The lower end of the

splint was fixed to a long tubal arm of an overhead bed frame.

October 30, 1924. Convalescence was uneventful. The stitches were removed and the wound showed healing by first intention.

Roentgen-ray examination, November 28, 1924, showed sufficient callus to allow for correction of the deformity. As there was marked flexion the lumbar spine was controlled by holding the opposite leg on a Thomas splint with the hip flexed and the knee extended. Complete correction of the deformity was secured in 5 weeks. Immobilization was continued and massage and exercises of the knee begun.

February 2, 1925, a plaster of Paris spica was applied and the patient allowed to walk.

February 12, 1925, the patient was discharged wearing a plaster of Paris spica.

April 4, 1925. The patient returned at intervals of one month. On this visit the roentgen-rays show complete correction of the deformity and solid union (Fig. 18). The hip is held in excellent position with only slight flexion and slight abduction. He walks with scarcely any limp (Fig. 19). The functional result is excellent.

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TRACTION ON THE STERNUM IN THE TREATMENT OF MULTIPLE FRACTURED RIBS[1]

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THE benefit obtained by skeletal traction on the sternum in a case of multiple fracture of the ribs, causing marked interference with respiratory exchange, seems to warrant a brief report in the hope that the principle utilized may prove of value, although the type of injury in which treatment by this method might come into consideration is most unusual. Doubtless the procedure here employed or some modification of it has been used by others, but descriptions of such cases are not frequent in medical literature. The indications for its application can best be studied by a consideration of the case in question.

Case. Hosp. No. 264248. J. G., a female, aged 12, was admitted to the hospital at 3 p.m., July 17, 1924. The patient had been run over by an automobile shortly before entrance, the machine having been seen to pass over the left side of the chest. The patient, a normally developed white child, was in profound shock at the time of admission; the blood pressure was 78–30, pulse barely perceptible, rate 140–150. The skin was of an ashy gray appearance, cold and clammy. There was extreme cyanosis, the mucous membrane and finger tips being almost purple. Respirations were very rapid, rate 50–60 per minute and labored. With each inspiration, requiring great muscular effort on the part of the patient, the sternum and anterior part of the left chest retracted to an extreme degree, so that it was obvious at a glance that there were several fractured ribs. On examination it was found that the second to the eighth ribs inclusive were fractured at points corresponding to the nipple line. Laterally the broken ends of the ribs could be seen protruding under the skin about 2 centimeters above the level of the medial ends. In the left axilla there was a localized area of subcutaneous emphysema. There was no evidence of fluid in the chest or in the pericardial sac. The heart was not displaced and was negative on auscultation. The abdomen was held rigid although there was no especial tenderness, spasm, or fluid demonstrable; in short, no definite evidence of intra-abdominal injury. The urine was negative.

Treatment. The usual first-aid treatment for shock was administered immediately. In addition, it being obvious that the patient was likewise suffering from a severe degree of anoxæmia, oxygen was administered. The effect of the latter was very satisfactory, a few inhalations serving to clear up the cyanosis, while respiration became much easier. However, immediately upon cessation of oxygen administration, the patient's condition became alarming, so that it was necessary to give oxygen inhalation intermittently. It was quite apparent that the cyanosis and rapid labored breathing were due to deficient ventilation, resulting from loss of rigidity of the thoracic wall. Each inspiratory effort caused a depression of the partly mobilized flexible sternum and the attached rib ends, rather than an entrance of air into the lungs. While it was possible for the moment to combat the anoxæmia by the use of oxygen, it was feared that further encroachment on the vital capacity as a result of hæmorrhage or reaction of the lung to trauma might be fatal, particularly in view of the profound shock. It was also obvious that if the sternum could be fixed, so that retraction did not take place, respiration would be easier. Accordingly traction was applied to the sternum in the following manner.

Technique. Under procain anæsthesia two small incisions about 1 centimeter long were made just lateral to and at right angles to the border of the sternum at the level of the third interspace, and were carried down until the edges of the sternum were exposed, great care being taken to avoid puncture of the pleura. An ordinary "bullet forceps," such as is used to grasp the cervix in gynecological cases, was used to grasp the sternum, a hook being placed into the lateral aspect of the sternum on each side and the forceps then being locked. It was found that a moderate degree of traction served to keep the sternum elevated during inspiration. The optimum degree was determined by hand and maintained by the usual method of weights and pulleys, attached to a rainbow frame.

Hospital course. On application of traction between 4 and 5 p.m., the respiration, which had been between 50 and 60 without the use of oxygen, dropped to 40, and was much easier, the patient complaining of no discomfort from the pull on the sternum. Further administration of oxygen was not necessary. The respiratory rate remained between 35 and 40 until late in the evening at which time it rose to 48, only to drop again to 38 within a few hours. The blood pressure rose steadily. On July 17, the day following the patient's admission, the patient's condition was much improved. She rested quite comfortably all day. The pulse rate was still rapid at 140, but had improved in quality, the blood pressure being 120–50. The patient's color was much better, although there was still slight cyanosis. Respiration was much easier and the rate had dropped to an average of 35. The traction forceps slipped from the sternum during the morning with the result that the pull was being exerted on the skin and fascia of the chest wall. Inasmuch as the traction thus obtained seemed adequate, no attempt was made to reapply it to the sternum. July 19, the second day after admission, the patient showed further improvement. The general appearance was much better, cyanosis being practically absent. The pulse was still rapid, the rate 130, but of good quality. Her respirations were 30 but quite normal in character. The patient appeared comfortable and did not complain of the traction, which was temporarily discontinued to note the effect on respiration. As its omission did not seem to influence the breathing, it was removed. The respiratory rate remained unchanged. However, there was again marked deformity of the chest with retraction of the sternum on inspiration.

The remainder of the patient's convalescence was uneventful. Attempts to modify the deformity by adhesive traction or by swathes were unsuccessful. She improved steadily and was discharged on August 7, at which time she was capable of ordinary activities requiring no great

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physical exertion. There was no union between the ends of the fractured ribs, as might be expected, and inspiration still caused considerable retraction of the sternum, but the patient apparently experienced no discomfort.

A follow-up examination on January 12, 1925, showed her to be in good health. There was no conspicuous deformity of the chest, although the line of fractured ribs could be felt, apparently united by bony union. The sternum was somewhat flattened, and there was a tendency to round shoulders. Her vital capacity was 2,342 cubic centimeters. Figuring from her surface area (weight 34.2 kilograms, surface area 1.17 square meters, Benedict and Talbot) this is very close to normal, according to the tables of vital capacity in children given by Wilson and Edwards (2).

If we assume that her vital capacity before the accident was 2,000 cubic centimeters there was a marked reduction during convalescence. It could not be determined shortly after the accident for obvious reasons, although it was clearly just sufficient to maintain life with great physical exertion. On the seventh day, July 24, when neither normal nor deep respiration caused apparent discomfort, measurements showed

Respiratory rate	29
Minute volume	7.4 liters
Amplitude	255 cubic centimeters
Vital capacity	553 cubic centimeters

On the fourteenth day, July 31, she showed

Respiratory rate	20
Minute volume	5.15 liters
Amplitude	252 cubic centimeters
Vital capacity	756 cubic centimeters

These capacities represent roughly 28 and 38 per cent of normal.

There were two outstanding problems in this case. The first, with which we are less concerned here, was that of combating shock. The second was that of attempting to readjust a badly crippled respiratory mechanism. It was at once obvious that the patient was suffering from a severe degree of anoxæmia caused by a subnormal respiratory exchange. Likewise the cause of the decreased respiratory exchange was obvious. The chest was no longer a cavity with firm walls. Inspiration caused a depression of the thoracic walls rather than a negative pressure within the lungs. Although the fracture resulted in complete separation of ribs on the left only, the flexibility of the sternum and ribs was so great that the right side of the chest wall could not be effectively expanded. The age of the patient was no doubt a large factor in the extreme mobility of the sternum. In an adult, with completely ossified sternum and stiffer ribs, it is doubtful whether the mobility of the sternum would be sufficient to interfere dangerously with respiration *per se*, even with nearly complete separation of the ribs from it on one side, although a bilateral injury might produce a similar condition. Under the conditions present, following this accident, the pulmonary ventilation was barely sufficient to keep the patient alive. The use of oxygen was clearly indicated but it was doubtful whether this alone would be adequate to maintain respiration. Accordingly an attempt to fix the sternum was logical.

By the technique used in this instance the application of hooks to the sternum for the purpose of fixation must be clearly recognized as a dangerous procedure. Any puncture of the pleura causing pneumothorax under these conditions would undoubtedly be fatal. This might readily occur either at the time of application, or by accidental pressure downward on the forceps at a later period. While the technique employed seemed at the time the obvious way to meet the condition, it is unnecessary to run the risk of pleural puncture. As an emergency measure, it would appear from the results in this case to be sufficient to grasp the skin and subcutaneous tissues over the sternum firmly with the forceps, and make traction on this area. In this way we believe sufficient pull could be given during the period of reaction from shock. More certain traction without danger of pneumothorax could be obtained for a short time by making two small drill holes a short distance apart in the median vertical line of the sternum, and engaging the forceps in the cancellous bone through these holes. Only the outer cortical tissue of the sternum needs to be perforated. While this can readily be done on the cadaver, in practice the mobile sternum would have to be fixed with a sharp hook so that sufficient pressure to make the drill bite could be exerted. If the drill holes are placed opposite the second and third intercostal spaces, they would ordinarily enter bone developed from the second center of ossification of the sternum, except in very young children, in whom a single hook pushed into the soft sternum will get sufficient resistance from the periosteum and presternal fascia.

Traction on the sternum is suggested only as a means of combating anoxæmia due to crushing injuries causing increased mobility of the thoracic wall. Secondarily, through reduction of the anoxæmia, diminution in the muscular effort needed for respiration, and through aiding venous return to the heart by increasing the negative pressure in the great intrathoracic veins, the degree of shock may be lessened. Although correction of the deformity may be secured in this way, traction is not suggested for this purpose and should be abandoned as soon as the pulmonary ventilation becomes sufficient. As shown in this case, a considerable deformity may be of no permanent importance. The technique used in this instance is too dangerous to recommend on account of the

possibility of pneumothorax. The principle employed, however, is believed to be sound, although crushing injuries of the thorax needing fixation of the sternum to promote respiratory exchange, are likely to be extremely rare.

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AN OBSERVERSCOPE FOR PROCTOSCOPY[1]

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IN no field is the physician less satisfactorily prepared than in that of rectal diseases. An astonishing percentage of physicians have never seen a normal rectum. There are several reasons for this: (1) the inherent antipathy of both patient and physician to any consideration of a rectal disorder; (2) the idea that the examination is disagreeable; and (3) the shrinking of patients from being clinical subjects, and many such so-called obstacles.

We have had great difficulty in the past in demonstrating lesions within the rectum and sigmoid. When one locates a lesion and looks away long enough to permit a second person to see, it is difficult not only to give an accurate description but to keep the proctoscope directed accurately. A deep breath, a cough, or the slightest movement of the proctoscope carries the object out of the field of vision. It is believed, therefore, that in perfecting this observerscope (Figure 1) a need has been fulfilled. The device[2], which consists of two eye-pieces, permits two persons to view the same area in the rectum at the same time, so there is no danger that the field of vision will be different for the two observers. The instrument is recommended chiefly to physicians who are engaged in teaching proctology, and to those engaged in general work. It can be made to fit the inflating attachment of any proctoscope.

The observerscope, consisting of two eye-pieces to be attached to a proctoscope, which enables two persons to inspect the same field in the rectum at the same time.

[2]The instrument may be obtained from the Electro Surgical Instrument Company of Rochester, New York.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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FEBRUARY, 1926

ACCIDENT AND INDUSTRIAL SURGERY

PROGRESS and advancement in human endeavor and achievement have been accomplished only when the necessity for improvement is recognized and plans devised to bring a change. Many years ago the surgical profession realized the need for better diagnostic methods, a better knowledge of surgical pathology, and better technique in the application of surgical therapy. As a result of this understanding elective surgery has made great strides in the application of all the principles involved in this branch of the art. This progress and advancement have been due in a large part to the efficient work that has been accomplished in the large clinics and clinical centers throughout the country where a vast number of cases could be studied and where an opportunity has been afforded for clinical observation, scientific investigation and research and for ascertaining accurately the end-results in this extensive clinical material.

We may point with pride to this accomplishment. However, the intensive study has been confined almost exclusively to elective surgery, and the field of accident and industrial surgery has been sadly neglected, for it is doubtful if there has been any material reduction in the mortality and morbidity in this class of cases during the past twenty years or since the firm establishment of aseptic and antiseptic surgery.

If this broad statement needs evidence to sustain it, analyze the fractures cared for in the larger institutions of our cities, and it will be found that the end-results in these cases both from an anatomical and functional view leave much to be desired and are probably no better than they were 20 years ago.

A committee was appointed by the American Surgical Association to investigate the results from our present methods of treating fractures. This committee made an exhaustive and comprehensive study of the situation and their report would seem to show the urgent necessity for some radical improvement in our methods of treating this common and serious condition which so often leads to permanent deformity and limitation of function.

Granting that the assumption is true that there is a great need for the betterment of our applied surgical therapy in the care of traumatic injuries how can this be accomplished?

Reasoning from analogy based on an analysis of the situation prevailing in the field of elective surgery it is a fair conclusion that much could be achieved from a centralization and segregation of injury cases, permitting the collection of a large enough number in one place to allow for an intensive study and investigation to be made of all angles of the problem.

As the situation is at the present time, no single man or group of men has the opportunity of seeing and studying a sufficiently large number of cases under the most favorable circumstances for intensive investigation. The observation of a large number of one class of cases stimulates thought and interest and research in such a way as to promote better methods of treatment.

In some of our large hospitals arrangements have been perfected whereby patients suffering with a given pathological condition have been segregated and grouped under one surgical chief and it may be pointed out that with this plan in operation the progress in the better understanding of all phases of that particular affliction has been most satisfactory.

The factors which influence this advancement in knowledge are obvious. If we remember the lessons learned in the war it is trite but true that the surgeons, actively engaged in the care of the wounded, improved their methods and became more efficient when the cases of a given injury were segregated and centralized. This afforded an opportunity to appoint the experienced, the specialized, and the best equipped surgeon to care for a particular class of cases.

The British and French Medical Corps evolved a system for the centralization of fractures during the year 1917 and from that time the improvement in their end-results was most gratifying.

A survey of the situation in that branch of surgery known as industrial surgery in America would indicate that the circumstances surrounding the care of a large proportion of injured patients, are influenced by the business methods of the insurance companies carrying the financial risks of the various corporations and building contractors. Some of these companies in their endeavor to minimize the financial outlay, have employed the younger and less experienced surgeons, and there has been little or no concerted effort made to improve the methods in the care and treatment of the injured.

Surgeons must come to feel keenly their responsibility in this department of the surgical art. It needs no wordy brief of profound argument to justify the conclusion that the present methods of caring for the injured are a great economic waste when the increased number of days of immediate disability and the more or less permanent disability that may occur is considered.

It would appear that the surgeons of America must be made to feel it their unalterable duty to study the problem from all its angles and in the broadest perspective and to devise some ethical and practical working plan to improve the present situation. True, much has already been accomplished and yet the efforts of the few have not been crowned with unqualified success.

A campaign of education must be inaugurated which will stimulate a broad interest in this all important subject which seems to have attracted surprisingly small attention as compared with the thought, discussion, and teaching devoted to elective surgery.

Such propaganda for enlightenment must originate in the larger surgical societies throughout the country and must be made broad enough to reach the industrial insurance companies. The logic must be such as to appeal to their sense of the economic advantage that must necessarily accrue to them in the better care of the injured patient, and in consequence the lessening of the number of days of disability.

It may be pointed out in this connection that the large Labor Organizations are cognizant of the necessity for improvement in the care of the men injured in industrial pursuits and in some States have considered the ad-

visability of proposing and supporting some form of state medicine as a remedy.

The thinker of the medical profession recognizes the fallacy of such a proposition and must take steps to forestall such a movement.

FREDERIC A. BESLEY.

EXTRAPLEURAL THORACOPLASTY

TUBERCULOSIS, "the great white plague," which a century ago, out of each 100,000 people claimed its 300 victims, today in city and country districts, has a mortality of only 100 in each 100,000, while some crowded cities have cut this rate to from 40 to 60 per 100,000.

Numerous observers have noted that many factors enter into this reduction of the death rate, that the white races are becoming more resistant to tubercle bacilli, in other words, are becoming tuberculized.

We know that this disease is no respector of races. The Chinese, even under the worst possible conditions of overcrowding, sanitation and hygiene, show no greater mortality tables than do the Caucasians, probably their greater age as a race and their longer exposure to infection having built up their resistance in spite of adverse living conditions. It is well known how vulnerable are the red and black races to this disease. Its ravages among the American Indians, free from tuberculosis until contaminated by the white carriers, are a matter of history. Bushnell has dramatically told how the natives of the Marquesas reacted to the disease, carried to them from an older civilization.

Robert Louis Stevenson tells how whole tribes in the short span of 2 or 3 years were decimated by it. He cites one instance in which the tribe of Hapaa, 300 strong, was reduced to 2 survivors in less than a year after contamination by tuberculosis.

Autopsy statistics among the white races show that from 85 to 90 per cent of all persons coming to the pathologist's table exhibit evidences of having been inoculated with tuberculosis, which has either failed to progress or has been overcome, a real tuberculization of the hosts.

Twenty years ago tuberculous infection of the cervical glands was common; now it is extremely rare. Bovine tuberculosis, especially in children, finds its portal of entry in the tonsils or the pharyngeal region and manifests itself early in the lymph glands of the neck; probably the now admitted infrequency of this disease is due to the testing of herds for tuberculosis, this and the pasteurization of milk destroying the menace from that greatest of carriers of bovine tuberculosis.

While the tuberculization of the race, the adoption of methods which minimize the danger from bovine tuberculosis, and a better understanding of how to combat the disease, has tremendously lowered its mortality, still its very omnipresence and the admitted mortality of 100 to each 100,000 people makes it a very real menace to society; even so, slowly but steadily progress has been made which offers hope of comfort and cure to the consumptive.

When the profession recognized and accepted the fact that rest, good food, and pure air formed the tripod upon which was based the cure of tuberculosis, they made real strides toward conquering the disease.

Superimposed upon this tripod came the Rollier of heliotherapy treatment. Then, as a further expression of rest, we were given artificial pneumothorax, which by the introduction of gas or air into the pleural cavity collapsed the lung and gave that diseased organ real physiological rest.

This treatment marked another milestone in the fight against the disease and helped

crowd still higher the steadily mounting curve which marked the incidence of cures.

While artificial pneumothorax is a therapeutic agent of great value, yet there remains about 20 per cent of the cases in which it is indicated but cannot be used. These are cases of advanced unilateral pulmonary tuberculosis in which synechia between the visceral and parietal pleuræ hold the lung expanded and prevent its collapse by air under pressure; cases which because of failure of this procedure are doomed to swell the mortality tables, which show that approximately two-thirds of these cases die early, whereas of those which have been successfully collapsed 66 per cent recover.

When there is failure of collapse after repeated attempts at artificial pneumothorax, then only should the formidable operation of extrapleural thoracoplasty be considered. This operation is indicated only in the advanced cases of unilateral pulmonary tuberculosis where the other lung is healthy, slightly involved, or exhibits healed tuberculosis. This operation as it was finally standardized by Brauer, Frederich and Sauerbruch, and performed today, consists of a long, sickle-shaped paravertebral incision, beginning at the root of the neck, parallels the spine above and swings out over the tenth rib below; subperiosteally, from 2 to 15 centimeters of all the ribs except the twelfth are removed. The evolution of the operation showed better collapse of the lung was obtained when the ribs were resected close to the spine behind, for the more mobile costal margins of the anterior ribs readily collapse with the collapse of the lung. This operation, although done in one stage by many European surgeons, has a lower mortality when done in two stages.

An interval of but 2 or 3 weeks between the two stages is dictated because of the rapid reformation of new ribs from the periosteum which has been conserved. These newly formed ribs tend to hold out the collapsed lung and defeat the object of the operation. This operation can be done entirely under local anæthesia, but by preference should be done under local anæsthesia supplemented by gas oxygen analgesia.

By its very magnitude and from the fact that it is performed upon people who are already ill and depleted by the ravages of their disease, this operation must of necessity carry heavy primary mortality within the first month. In the hands of all operators this mortality is approximately from 10 to 15 per cent, yet when we stop to consider that almost all of these people are doomed without surgical relief, we believe the hazard of this mortality must be accepted. No case should be subjected to extrapleural thoracoplasty until it has been under the extended observation of an experienced medical specialist in tuberculosis.

Studying reports of 1,024 operations Alexander found that there were 32 per cent of cures and 26 per cent of marked improvement shown. Considering that these people cannot recover without surgery, this is ample argument for the operation of extrapleural thoracoplasty.

A. A. Law.

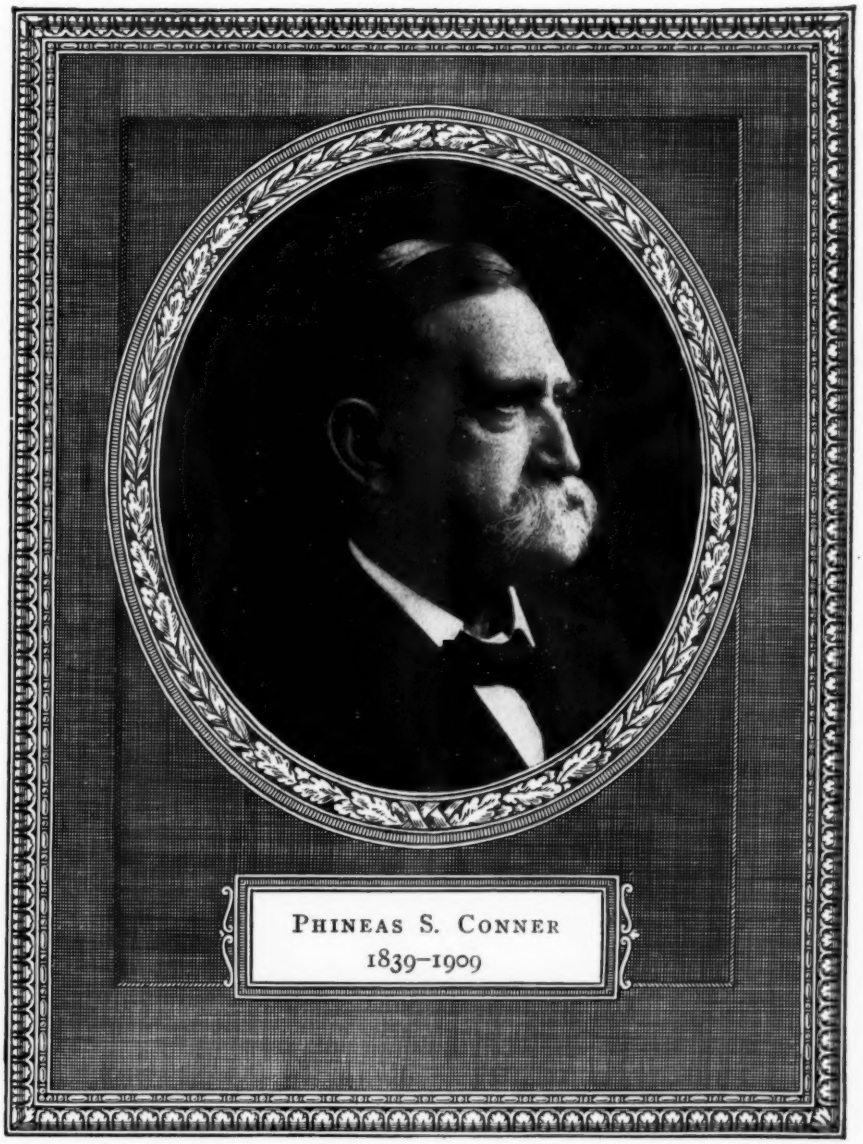
MASTER SURGEONS OF AMERICA

PHINEAS SANBORN CONNER

MY INTRODUCTION to Phineas Sanborn Conner II occurred at 6 years of age when I was awaking from that deepest sleep which comes from a tumble over the banisters and landing on one's head. Even then, the man's personality made a lasting impression. He appeared as a giant with a beak of a nose and a great long bristling moustache. He was holding my arm but he did not hurt. His big hands were firm and tender. His voice was gruff and big, but kind. Out of his eyes came the look of a friend. He was a giant but not the story-book kind, and in my child's mind I quickly sensed the something in this personality that took from the beak nose, the firm set mouth, the bristling moustache, those story-book attributes.

Phineas Sanborn Conner, Jr., A.B., A.M., M.D., LL.D., was born in Westchester, Pennsylvania, August 23, 1839. His father was a practicing physician of modest, retiring disposition, well informed but loath to display publicly his ability. The mother, Elizabeth Angelina Fair Prichard Hook Sanborn Conner, was an energetic scholarly woman who greatly influenced the molding of her son's character. Doctor Conner's ancestral tree is an illustrious one and contains the names of "Father" Bachiler, who landed in Boston Harbor in 1632, Daniel Webster, Justine Smith Morill, Seth Low, Nathaniel Hawthorne, and John Greenleaf Whittier. The last describes the "Bachiler eye" as brilliant, keen, piercing, penetrating. Such eyes had Doctor Conner.

The Conner family moved to Cincinnati in 1844. In 1859, after an education obtained in the Cincinnati schools, he was graduated from Dartmouth College. Returning to Cincinnati, he attended lectures at the Medical College of Ohio, session 1859–1860, then at Jefferson Medical College, from which he was graduated in March, 1861. During these college years, he spent some time as apothecary and acting physician in a Connecticut hospital for the insane, and about six months in doing what was then termed "walking the hospitals" in New York City. In November, 1861, he responded to the Union call. In August, 1866, the war over, he resigned and came home, having been brevetted major for "gallant actions and meritorius services." His teaching career began at once, with the professorship of surgery in the Cincinnati College of Medicine and Surgery, at the age of 27. This was followed, in rapid succession, by other professional appointments in the Medical College of Ohio, culminating in the professorship of surgery



PHINEAS S. CONNER
1839–1909

UNIV. OF MICH.

in 1887. For 24 years he was professor of surgery in the Dartmouth Medical School.

It was nearly 15 years before Doctor Conner had a remunerative private practice. These were years of character building. In the library of his old home in Cincinnati, he surrounded himself with his heroes, Vesalius, Harvey, Paré, and Sir John Hunter. These he studied and their ideas became his, thus crystallizing his character.

The early opportunities presented to Doctor Conner so broadened his experience and clarified his vision that he was enabled to find the solution of many problems. He belonged to a generation of men who, of necessity, developed keen powers of observation. With a history of the case, and their highly trained special senses, they accomplished wonders in arriving at a correct opinion. He was often heard to say that the X-ray machine was beginning to have a bad effect because its "short cut methods" undermined one's ability to observe. Probably the essence of his power lay in his ability to concentrate on the vital factors of any problem and to disregard unessential details. As a diagnostician, he was of the best, and many times showed an intuition that appeared fairly uncanny. On one occasion, when talking to him of this faculty, he said: "Intuition, sir, is subconscious reasoning based on previous experience."

Next to his family and friends, the medical college, medical education, and teaching were his greatest interests. As a teacher, all agree regarding his unusual ability; but one criticism might be made, that he lectured on a plane above the capacity of his students. He used the didactic method with little of demonstration to illustrate. This method, perhaps, was a fault of the times, as the then customary two short school years to an M.D. degree gave but little opportunity for practical laboratory or bedside work. He was most stimulating as a teacher, not only because of his knowledge of his specialty, but because in his lectures the students had the advantage of his broad education in all the collateral branches of learning. Perhaps his best work as a teacher of surgery was done in the amphitheaters of the old Cincinnati General and Good Samaritan Hospitals.

Doctor Conner, in an address at the opening of the New Medical Hall of Jefferson Medical College, Philadelphia, in 1899, gave his idea of medical teaching as follows:

"The logical, condensed, lucid presentation, in lecture form, of the summation of the wisdom of the past, the science of the present, as they have become a part of the accomplished scholar, the dextrous experimenter, the experienced practitioner, given in language, terse, lucid, graceful, if it may be, is far more impressive, far more instructive, far more effective than the study of any textbook."

From the "Historical Address" made at the Centennial exercises of the Medical Department of Dartmouth College, in 1897, these sentences are taken: "But the knowing is only one side, and that the lesser of medicine; there is also

the doing, and the art must be cultivated, even more than the science. The great end and aim of medical education is to make not scholars, not scientists, but healers of the sick."

Surgically, Doctor Conner's greatest contribution to the sum total of world accomplishment was his demonstration, in 1883, at the Good Samaritan Hospital, Cincinnati, that the complete removal of the human stomach was feasible. A great deal of his work was original, and of a daring pioneer type; much of it showed a recognition of the advances made by others, and the choosing of the good points from their work. As a surgeon, he was alert, cool, practical. Whenever he appeared in the operating arena it was as the central figure. Precise in touch, supple in movement, he added the polish of the finished artist to the nonchalance of the experienced operator. Doctor Conner had an individuality that stood out at all times in bold relief, neither conventional nor stencil made. His was an intense nature with the supremely confident air of the born chieftain.

It has been said that his military training was a large factor in producing an outward appearance of rough severity, brusqueness, and irritability, which, to some, made him unapproachable and forbidding. Rather might not these characteristics be attributed to the long and rough road he traveled in the early years of his professional life, and an added veneer he assumed to cover a sensitive warmheartedness not compatible with the requirements of the surgery of the preanæsthetic era? He was not much given to evaluating men publicly, unless aroused to anger, and then he spoke in no easily mistaken words. Someone has said: "The asperities of Doctor Conner's character were an indication of his strength." This, combined with his peculiar eagle eyes, made a personality from which the timid usually shrank. The truth, whatever it may have been, was the strongest card with which to win his friendship. His attitude toward people at large was so in contrast to his attitude toward his close friends and his family that one can almost truthfully say his was a dual personality. To the one, stern, sharp, quick, gruff, austere, and overbearing; to the latter, gentle, considerate, companionable, and devoted.

The spoken word moves at the time and influences for the season, but the written words remain. Few men have written more voluminously and better than did Doctor Conner. His contributions of written words that remain are almost innumerable, and these can be found closely scattered through the medical literature of the times. The subjects of these contributions practically cover the entire field of surgery, as then understood. He was associate editor of at least three surgical textbooks. He was honored by being called upon to give addresses at many national and local affairs.

Besides the army rank early obtained, and the later medical college positions held, Doctor Conner was president of the Cincinnati Academy of Medicine, Ohio State Medical Association, the American Academy of Medicine, and the Ameri-

can Surgical Association. At the close of the Spanish War, President McKinley appointed him to serve on the examining board investigating the conduct of the war; this service necessitated the abandonment, for months, of his private practice. He was a member of the Loyal Legion, Sons of the American Revolution and of Colonial Wars. The title of LL.D. was conferred by Dartmouth in 1884.

Doctor Conner was married in December, 1873, to Julia E. Johnston of Cincinnati, and his devotion to this woman was ideal. Three children were born to them. It was a revelation to see him in his home. Hard as it may be for his casual acquaintance to believe it, there is ample proof that Doctor Conner loved a joke, for the joke's sake, and was full of fun and quiet wit. He once said about children: "What with the plague of their living, and the fear of their dying, there's no fun in them." All day long he would go about his business like a storm cloud, but the minute he passed the threshold of his home, a smile lighted his face. He became apparently the youngest member of the family, no longer the ruler but the ruled; all this, following a day of impetuous, driving work, when assistants, internes, nurses, feared him and bowed to him as a strict disciplinarian. His love of home and family was intense, and to his wife he was the essence of chivalry. The death of Mrs. Conner, in 1899, was the beginning of a break, from which he never completely recovered. Doctor Conner died just as he wished, suddenly and without warning, March 26, 1909.

A word picture of Doctor Conner cannot be better completed than to quote a few remarks made by him over thirty years ago, in one of his valedictory addresses to the students of the old Medical College of Ohio, which undoubtedly express the rule of life by which he lived.

"Wherever you may go, whatever you may do, be earnest, be honest, be faithful and hopeful. The life of the physican demands the exercise of the highest qualities of mind and heart. If you would live it aright, be studious, be thoughtful, judicious, watchful. It carries with it grave responsibilities; it brings with it full rewards. There is in it labor and cares and anxieties; there comes from it the enduring satisfaction of beneficent work well done. It teaches us to be considerate, charitable, humane. It opens to us the brightest and the darkest chapters in a man's history. It reveals the heights of human affection; it lays bare the very depths of human depravity. There is nothing in life that it does not acquaint us with. From now on until the great change comes to each of you, it will have no beginning, it will have no end. Days and nights, and times and seasons are as if they were not, for the doctor is always on duty. In the thick of the fight or waiting orders with the reserves, guarding the outpost or leading a forlorn hope, he is ever full-armed. As the occupation is a constant one, so must the preparation for it be a constant one. Mind and body must be kept in the best possible order. Sobriety and studiousness must characterize the life. . . . In our own country, we now seem to be approaching a point at which a choice of way must be made. The commercial spirit of the age is influencing all persons, affecting every occupation. Medicine must either receive it and direct it, and secure from

it, its inherent good, or must go over to it, be absorbed in it, be lost in a mere trade, and that a degraded and degrading one. In the tricks of the charlatan there is nothing new; finding medical idols with feet of clay is nothing strange. The threatening feature of the day is the widespreading of a spirit in the air, that would infect the medical world with the germs of an all-grasping greed and uncontrolled ambition that makes the highest good of medicine the acquisition of money and the praise of the people. Do not mistake. . . . The duty of each one of us today, is as it has ever been, to work in this our vocation and art truly, rightly, and without deceit, so that it may be to the glory of God, to the common weal and our further knowledge, and finally to the health and safeguard of the people. Freely you have received, as freely give." DUDLEY WHITE PALMER.

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LIBER PRIMVS DE GENERATIONE HOMINIS.

CAPVT I.

De genitali semina, quid sit, vnde & quomodo nascatur.

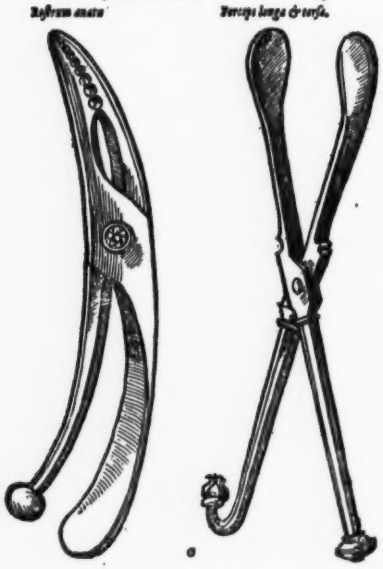
PRocreationem naturalem hominis, talem omnino obseruauimus, qualem omnis generis stirpium generationem animaduertimus. Vt enim illa ex semine sui quaque generis tellari commisso, germinent, augeantur, & ad perfectam sua natura formam naturaliter excrescant: ita homo quo-

LIBER QVARTVS,

DE VARIETATIBVS NON NATVralis partus, & earundem causis.

Rostrum anatis

Forceps longa & torta.



23. Anno 1512. Romæ nonum monstrum natum est, quod habebat cornua in capite, alas duas, brachia nulla, pedem vnicum vt auis rapax, oculum in gena, sexum vtrumque, in medio pectore ypsilon & crucis effigiem. Hoc alii quidam interpretati sunt: Curam pertendere superbiam: alas, leuitatem & inconstantiam: carentiam brachiorum, defectum bonorum operum: pedem rapacem, rapinam, vsuram & auaritiam omnimodam: oculum in gena, solum ad res terrenas respicit: sexum vtrumq;, Sodomiam. Propter hæc autem peccata Italiam sic eo tempore bellicis contritionibus afflixit. T vero virtutis & vigorem esse salutis: quare si vitijs hic relictis, ad virtutes & ad Christi crucem, id est, vnicum eius vocatum meritum, reflexionem & pacem denuo inuenturos esse. Fiebant autem hæc Ludouico, Gallorum rege, sub Iulio II. pontifice Italiam vastante.

Rabi Moses in Aphorismis particula 25. sic scribit: In Sicilia accidit Eclipsis solis magna, & illo anno mulieres filios deformes ac bicipites peperere plurimos.

An homo ab homine possit euadere.

Quæritur hic, Vtrum brutæ concipere possint ab hominibus, vel etiam vicissim homines a brutis. Hoc autem fieri posse tribus assumptis rationibus. Primo naturali appetitu. Secundo, prouocatiuis naturæ ex delectatione. Tertio, virtute attractiua matricis, quæ in brutis & hominibus similis est. Exemplis in promptu sunt. Plutarchus enim in Paralelis minoribus hoc habet: Ariston Aristonymum Ephesium filium Demophati, cum edisset mulierem, cum ea rem habuit, quo tempore resolutæ puellam formosissimam peperit.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

"THE OBSTETRICS BOOKLET" OF RUEFF[1]

THE practice of obstetrics in the early part of the sixteenth century had not kept pace with other medical branches and was still in the hands of ignorant midwives and charlatans. Eucharius Roesslin had done his bit to try to raise its standards with his "Rosegarden" but, though the volume passed through many editions, little was accomplished. The time was ripe, therefore, for a new book on obstetrics. This was seized upon at only a few years' interval by two men in two countries. The first of these was Jacob Rueff of Zurich, Switzerland, who in 1554 published "A very cheerful booklet of encouragement of the conception and birth of men and its frequent accidents and hindrances, etc.," at Zurich, and a second edition appeared in 1559. Why the volume should have been called "cheerful" it is hard to understand as it is anything but that, but there the title stands: "Ein schön lustig Trostbüchle, etc." An edition printed in Latin appeared the same year, 1554, in which the title reads, "Concerning the conception and generation of man, etc." Shortly after the author's death in 1558 the incongruity of the German title was apparently recognized and the book was reprinted at Frankfurt a. Main in 1580 under the title "Midwives' Book from which one is taught all the secrets of the female sex, etc." The book remained extant for over a hundred years, the last edition being printed at Amsterdam, Holland in 1670. The volume I examined is one of the Latin editions printed at Frankfurt, in 1587.

When one reviews Rueff's life and his manifold activities, one at first wonders why he happened to write a work on obstetrics, but looking the book over carefully seems to answer the question. Where he was born is in doubt; some authorities say in the Rhyntal; others in Wuerttemberg. When he was born is unknown as is also the date when he came to Zurich and settled there. He was prominent in many fields. He wrote astronomical notes for an almanac and furnished the tables for blood letting. He was a popular poet and folksong writer. He was also a great enthusiast for religious freedom, so much so that he served twice (1529, 1531) with the troops of Zurich against the Catholic cantons. He was likewise a dramatic writer and in 1535 his play "Hiob" was produced and in 1545 his "Wilhelm Tell." He seems also to have been well known in medicine, in Zurich at least, for in the almanac he is described as surgeon and lithotomist of Zurich. In addition to his obstetrics he wrote a little book of 59 pages on tumors which was published in Frankfurt in 1556 and republished in Amsterdam in 1648 and 1662.

The book follows the "Rosegarden" fairly closely. Additions are made as Rueff advises cephalic in addition to podalic version and describes its performance in detail. He advises and illustrates both toothed and smooth forceps for the extraction of the dead fetus, but does not advise their use on the living child though the smooth forceps (see illustration) look as if they could have been used for at least a low forceps delivery. The various types of abnormal positions of the fetus *in utero* (some of them imaginary) are illustrated and serve to show that the author knew the commoner malpositions.

It is in that portion of the book devoted to monsters that it seems to me his desire to write the book crops out. When we remember the man was a religious zealot here was his opportunity to apply this phase of his character to medicine. At this time the theory that the devil worked his will on pregnant women was rife. The great Luther himself believed that the devil substituted changelings for normal children and gave the signs by which they might be recognized. But more than that, these changelings and monsters came as the punishment for sin. So Rueff devotes ten pages of his book to their illustration and description. How better could he help to save the people from sin than to give the backing of science to the penalties of religious error? He illustrates first the intra-uterine amputations, authentic without doubt. Then double headed and double bodied adults and infants; Siamese twin anomalies; the remains of fetal inclusions such as a head protruding from the abdomen; then club hands, club feet, and double hands. So he takes in fairly well the range of possibilities. But then he leaves the possible and goes to the changeling and describes and illustrates instances of infants with claw hands and feet; eyes in the abdomen and extremities; animal heads protruding from the joints; infants with animal heads (even one with an elephant head), and finally as a climax an infant with a horn, wings, and the sign of the cross surmounted with upsilon on its breast. There were also other abnormalities but the interesting point is, that to each he gives an interpretation on a religious basis. Was his desire to bring this material forward the reason for his writing the book?

[1] Reviewed through the courtesy of the John Crerar Library, Chicago, Illinois.

REVIEWS OF RECENT BOOKS ON GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Missouri

THE specter of "race suicide" looms large in Western Europe. Publications *pro* and *con* the limitation of births, emanating from medical and lay sources, have repeatedly been reviewed in these columns. The problem is so intricate and affects every thinking man or woman in this as well as in any other country to such an extent that it is incumbent on us to know and carefully weigh all arguments before forming an individual opinion which holds its ground well between prejudicial antagonism and heedless passion. The following three booklets will illustrate the point.

Vollmann has been commissioned by the Union of German Medical Societies to present to lay readers a concise and objective exposition of the facts involved. His pamphlet is entitled *Abortion as a National Disease.*[1] One cannot but concede the use of the term "national disease" when one reads that, within the last few decades, abortion has increased in Germany from 9 to 40 per cent, and that of these, 95 per cent are "criminal" abortions. Simultaneously, the birth rate shows a continuous decline, and the author claims that the time cannot be far distant when as many will die as are born. A subsequent inversion of the ratio is then inevitable, that is, the death rate will exceed the birth rate—"the beginning of the end." No wonder that social economists view the future with apprehension. Abortion is far more dangerous to life than the lay mind imagines. In Halle and Berlin where accurate statistical data were obtained, the mortality of abortion was almost seven times greater than that of full term labor!

The alarming spread of abortion has, to a large extent, its explanation in economic, social, and psychic causes. The complexities of modern life, the author admits, have created a widespread disinclination to rear a family, a veritable "fear of the child," but abortion is only a symptomatic, not a causative remedy of the trouble. There was a kernel of truth in Malthusianism, but neither this nor any of the subsequent movements can stand the test of present day criticism.

Laws pertaining to abortion have been promulgated by the peoples of antiquity and persisted through the ages in all civilized countries. Should the laws existing in Germany at present be changed or altogether abolished? What effect would such a step have on the morality of the nation, on the increase of venereal disease? In any case, suppression of abortion by means of the law cannot possibly accomplish as much as a truly etiological treatment which takes into consideration the various causes of this "epidemic" of abortion.

I refrain from enumerating the author's suggestions because I feel that this booklet should be read by everyone who has the common weal at heart. For with us, too, the problem of abortion has reached a threatening stage. The American reader will find Vollmann's thesis clear and instructive, concise, sympathetic, and free from any disturbing emotionalism. It is the latter, in particular, which in the past has so often obscured the issues under discussion. Our author has preserved a judicial mind to a remarkable degree. His unprejudiced attitude shows itself, for example, in the case of rape of white girls by colored French soldiers in the occupied area. Such instances occurred quite frequently, but it is greatly to the credit of the author that he admits that in some such cases not much force had been needed to break down the resistance of the victim. *Only* if a true assault has been definitely established to the satisfaction of the court, does the author feel that existing legal restrictions against interruption of pregnancy might be relaxed.

WEINZIERL[2] covers much the same ground as Vollmann. His thorough statistical studies, however, are addressed to medical readers. He was primarily interested in investigating the motives which drive women to an illegal interruption of pregnancy, but the lack of truthfulness on the part of the interrogated patients rendered such an inquiry impractical. He then approached the subject from a different angle by trying to ascertain why pregnant women had *not* resorted to abortion. This question is not as absurd as it might seem on first sight. The patients whom Weinzierl interviewed were without exception illegitimate mothers, and these are, under present day conditions, almost logical candidates for criminal abortion. The results of such an investigation should, then, supply valuable hints as to the prevention of abortion. By collecting data from 500 such patients, a sufficiently large material was brought together from which reliable conclusions might be drawn. It would lead us too far to reproduce the answers obtained and tabulated by the author. Suffice it to say that in his deductions he arrives at practically the same suggestions as does Vollmann, yet, from an entirely different approach. These consist, briefly, of protection of large families by reduction of taxes, educational subsidies, preferment in industrial employment, etc.; education in school with a view of raising the moral level of the people; prenatal and postnatal care of mothers, whether married or illegitimate; legal and institutional protection of children born out of wedlock; etc.

[1] Die Fruchtabtreibung als Volkskrankheit; Gefahren, Ursachen, Bekaempfung. Im Auftrag des Geschaeftsausschusses des deutschen Aerztevereinsbundes. By Sanitaetsrat Dr. Vollmann. Leipzig: Georg Thieme, 1925.

[2] Die Uneheliche Mutterschaft. Eine socialgynaekologische Studie, zugleich ein Beitrag zum Problem der Fruchtabtreibung. By Dr. Egon Weinzierl. Berlin and Vienna: Urban & Schwarzenberg, 1925.

To discuss whether or not all these suggestions are feasible or applicable to our own conditions, is beyond the scope of a review. The study of this pamphlet, however, must be warmly recommended to any sociologically minded physician.

I AM not equally positive about the book by Rout.[1] In fact, I was so afraid lest I might not do justice to it that I asked a friend of mine to review it for the readers of this journal. Her comment follows.

"*The Morality of Birth Control* is an enthusiastic and feminine revelation of this perplexing question. In thirteen chapters and an appendix, Mrs. Rout presents the subject hygienically and, at times, somewhat hysterically, inasmuch as she establishes for her thesis the hypothesis that mankind's capacity for improvement 'is at present locked up in the bodies of womankind. The means for its release is the natural constructive chastity of enlightened, free, and independent womanhood. Toward that goal, the first step is the education of young unmarried women as to the physical basis of marriage and the meaning of marriage for the existence and evolution of the race; the second step is the education of young wives to the control of their own fertility, so that there may be no unwilling maternity. Then, and not till then, the evolution of man will be resumed! The individual happiness of romantic lovers will not be interfered with. . . . At present, women are not the mothers of the race: they are each individually the private property of some individual man. Once they are released from this bondage, made socially and economically free, their natural chastity will make them faithful to the men they love: Virtue will be enthroned and the race will evolve.' All this, however, with the universal use of contraceptives!

"It is very evident from the above that Mrs. Rout's experience as a law court reporter and social worker has somewhat prejudiced her judgment as a married woman, which she now is. Consequently, throughout her book, she is polemical rather than practical, sentimental rather than scientific. However, she is always amusing and interesting. Her humor is prolific. For instance, she says, 'Total abstinence from sexual intercourse may be said to be the only absolutely certain 100 per cent foolproof form of birth control.' Again, 'Abstinence has no more and no less value in the cultivation of sound ethics than starvation has in the cultivation of sound digestion.'

"Birth control is not a modern invention. Mrs. Rout says it is thousands of years old, older than the Bible in which control must have been employed because we find frequent exhortations 'to increase and multiply.' She insinuates that both the state and the church unconsciously practice birth control; the state in its regulatory laws for marriage and divorce; the church, in its definition and insistence upon chastity and its imposition of celibacy upon millions of nuns and priests. War and society practice it in many ways but specially in condemning the 'surplus women' to perpetual virginity. Mrs. Rout traces the gradual rise of sex ethics through the evolution of our domestic departments, such as the cave, harem, and home. She shows how social ethics have graduated from infanticide and feticide to prevention by means of contraceptives. However, race improvement is a positive, not a negative process. It is not enough to destroy or prevent the birth of the unfit, but it is necessary to produce the fit through selection or eugenics and the careful 'spacing' of births. And finally, Mrs. Rout establishes the hope of the future of the race upon the natural chastity and monogamous instinct of women.

"Being a woman myself, I must confess that I am both startled and flattered by Mrs. Rout's naïve and original book which I recommend as entertainment to the wise and propaganda to the unenlightened!"

PUBIOTOMY and symphyseotomy are much more in vogue in France than in most other countries. These operations formed the official subject for discussion at this year's meeting of the French Gynecological Society, and the transactions indicate that their popularity remains undiminished. The cervical cæsarean section, which has supplanted these operations in Germany and is gaining ground both in this country and in England, has not found much favor in France. Another rival, however, has risen in the form of the "exteriorization" operation of Portes, of Paris. The steps of this novel and interesting procedure are, briefly, as follows: The pregnant uterus is lifted out of the abdominal wound and the latter is quickly closed behind it. The uterus is then incised, the child extracted, and the uterine incision sutured. The uterus remains outside of the abdomen for several weeks, protected of course, by suitable dressings, until involution is complete, when the abdominal wound is again opened and the uterus restored into the pelvic cavity. In a recent inaugural thesis, Scemla[2] endeavors a comparison between the Portes operation and the operative enlargement of the bony pelvis. He enumerates the indications for the two methods of delivery, describes their technique, illustrates his contentions with case reports and, finally, draws a parallel between these procedures. Inasmuch as pelviotomies date back 30 years, and the exteriorization operation is barely two years of age and numbers only seventeen observations, such a comparison strikes me as somewhat premature. As it is, the author arrives at the conclusion that in cases of contracted pelvis with or without infection, pelviotomy is distinctly superior to the operation devised by Portes.

[1] THE MORALITY OF BIRTH CONTROL. By Ettie A. Rout. London: John Lane, the Bodley Head Limited, 1925.

[2] INDICATIONS RESPECTIVES DES PELVITOMIES ET DE LA CÉSARIENNE SUIVIE D'EXTÉRIORISATION TEMPORAIRE DE L'UTÉRUS. By Docteur Jules Scemla. Paris: Octave Doin, 1925.

WE want to give Fulkerson credit for the idea of writing a book on gynecological urology, the first, I believe, in American literature[1]. The interrelationship of genital and urinary tracts is so intimate, and reciprocal influences of pathological conditions in the two systems are so frequent that a special treatise on this subject would be decidedly welcome. In such a book one would naturally expect to read something of the author's views on the importance of cystoscopy in determining the operability of cervical cancer; on the therapy of vesical irritation following uterine radium treatment; on the serious effect of pyelitis on the outcome of gynecological or obstetrical operations; on modern views regarding the etiology of pyelitis in pregnancy and the prevention of recurrences; on the evolution of surgical treatment of incontinence of the bladder from Kelly's urethrorrhaphy to the pyramidalis operation of Stoeckel; on the ureter in prolapse of the uterus. But of all these and other special problems which concern the gynecologist in the study and treatment of urinary affections, not a word is said in Fulkerson's book. Instead, we read, perhaps in amplified fashion, what is usually found in books on male genito-urinary diseases and a good deal about nephrotomies and pyelotomies, nephrectomies and cystectomies, and other procedures which are plainly outside our scope and equally plainly belong to the domain of the specialist in urology. The bibliography is largely limited to contributions in domestic journals of the last 3 or 4 years. Yet, gynecological urology, as a subdivision of gynecology, is more than 20 years of age; and if the author had not almost altogether excluded foreign references, he might have found valuable material to incorporate in his book.

In its present form the book represents urology in women rather than gynecological urology, which means something entirely different. Yet, the original idea is much too good to be abandoned, and we hope that the author, by a thorough revision, will make his book more serviceable to gynecologists and all those who treat urinary affections in women.

BY diseases of ovulation Dalché[2] understands all the phenomena which result from disturbances in the evolution of the egg cell from its primordial state to its maturity, and of the follicle from its first appearance to its rupture. Our anatomical knowledge of the conditions involved is very meager; hardly, that experimental parthenogenesis, the effect of X-rays and radium on animal and human ovaries, and observations made on the offspring of radiated mothers permit us to assume the action of chemical, physical, and mechanical irritations. For the most part, the causes of the diseases of ovulation must be sought in heredity or early infancy. Thus, tuberculosis, syphilis, alcoholism, lead poisoning, advanced age of the parents, acute infectious diseases, fatigue, and undernourishment of the child may account for a weakening of the ovaries. Clinically, this debility of the ovaries manifests itself in various definite syndromes which are grouped under the heads of infecundity, amenorrhœa, and dysmenorrhœa, and receive detailed consideration in separate chapters. Yet another clinical entity is that of "menstrual ovaritis" to which the closing chapter of the monograph is devoted. The author finds it somewhat difficult to suggest a precise definition of this form, and proposes to call it an ovaritis due to defective ovulation, an *ovarite ovigène*. Considering the fact that ovaritis implies an inflammatory process, it seems to me that we may accept this definition only for want of a better word, provided we bear in mind that non-infectious causes and even accidental factors such as traumatism, emotional shock, chilling, etc., may produce the condition in question. The symptoms, complications, prognosis, diagnosis, and treatment are fully discussed in each chapter.

What Dalché says, is always well worth hearing. In his latest publication he has given us a fluently written, exceedingly interesting and important chapter of medical gynecology which distinctly merits serious consideration.

THE systematic campaign against cancer, which was initiated by the gynecologist Winter in Germany and spread over a large part of the civilized world, has led in this country to the formation of the American Society for the Control of Cancer and to the founding of special hospitals for the study and treatment of cancer, such as the Barnard Free Skin and Cancer Hospital in St. Louis, the Memorial Hospital in New York, and the Huntington Memorial in Boston. And now a colleague in far away Brazil has taken up the work in his country. Monjardino[3], of Rio de Janeiro, endeavors by his monograph of 243 pages to arouse the interest of the profession in early diagnosis and prophylaxis of cancer. This disease is steadily increasing in Brazil though it is not as common as in other countries. This relative paucity disproves, incidentally, the claim of Bulkley that the abuse of coffee is one of the causes of cancer; for among Brazilians the use of coffee is "a vice rather than a mere habit." Parenthetically, I would add that the yearly increase is, as in other countries, probably due to improved diagnosis. After giving a brief historical sketch of our knowledge and the numerous theories concerning the nature of cancer, the author proceeds to a detailed exposition of the ways and means adopted in various countries to stem the progress of the scourge. We learn from this chapter that in Brazil attempts in this direction date back to 1904, but that they have remained sporadic. Recently, however, several radiological institutions have been founded or are in

[1] GYNECOLOGIC UROLOGY. By Lynn Lyle Fulkerson, A.B., M.D., F.A.C.S. Philadelphia: P. Blakiston's Son & Company, 1925.

[2] MALADIES DE L'OVULATION. By Paul Dalché, Médecin Honoraire de l'Hôtel-Dieu. Paris: Vigot Frères, 1925.

[3] CANCRO DO ÚTERO. Apontamentos para o estudio e regimento da sua profilaxia. By Jorge Monjardino. Rio de Janeiro: Pimenta de Mello and Company, 1925.

process of construction, and a slowly accumulating medical literature bears testimony to the fact that the importance of the subject is permeating wider circles. A separate chapter is devoted to cancer of the uterus in particular. The section on pathology which is very well presented would have been improved by a few well chosen pictures; but there are no illustrations whatever in the monograph except a reproduction on the title page of the cancer of Ambroise Paré, the crab with claws and long legs. As to treatment, the value of surgery is dwelt upon rather briefly; radiotherapy is emphasized "though it is still too new to permit of definite conclusions as to its efficacy." More emphasis, than with us, is laid on organotherapy, serum and vaccine treatment, and hypodermic and internal administration of various metal and biological preparations. It seems to me that in this particular section, the author has left the path of actual experience and lost himself in the maze of speculative and unproved remedies. He might have rendered a better service to his compatriots by calling to their attention definitely tested methods of treatment of inoperable cancer of the uterus such, for instance, as the acetone treatment which now has stood the test of 20 years. The closing chapter contains thoughtful and detailed plans for a national Institute of Cancer and an outline of a nation-wide campaign.

We welcome in Monjardino's treatise a new ally in the fight against a relentless foe.

THE fifth edition of Jellett's book[1] has been enlarged by the insertion of sections on tubal insufflation and pneumoperitoneum, Sampson's endometrial implants and ovarian transplantation, and other new subjects. Even with the additional 100 pages, the work holds a happy medium between the all too abbreviated manuals and the bulky tomes of some recent textbook writers. Its makeup is distinctly pleasing, paper and type are of the best, and the illustrations are numerous and well executed; among them there is an unusually large number of colored pictures and plates. The author who now lives in New Zealand has successfully overcome the difficulties imposed by the great distance which separates him from his publishers in London. There can be no doubt as to the author's ability as a teacher. His insistence on pathology, both gross and microscopic, and the lucidity of his descriptions prove it; and I was glad to acknowledge it in a previous review[2].

At that time I took occasion to mention a few shortcomings and omissions which slightly interfered with the full enjoyment of the reader, but these have not been corrected in the present edition. The chapter on vaccine treatment in both editions has been contributed by Dr. Rowlette, and a comparison of the two brings out the interesting fact that this author has found no reason to change his views in the past 9 years. Gonococcus vaccine has continued to yield remarkable results in his hands. In gonorrhœa of the vagina and uterus, complete cure seems to be the rule though the treatment may consume considerable time. In ascending gonorrhœa of the tubes, vaccine, if given in time, may prevent salpingitis developing into pyosalpinx and thus prevent sterility. Since the vaccine therapy has been disappointing to the great majority of writers, the continued success in Rowlette's experience must attract our attention.

A GOOD Spanish textbook of obstetrics looks amazingly much like any American or German textbook as to shape and size, arrangement of the subject matter and illustrations. Such, at least, is the case with the textbook by Recasens[3] which recently appeared in its fifth edition. I have looked through the work, largely with a view of discovering wherein Spanish thought and practice in obstetrics differed from ours, but I find extremely little to report. This is, after all, not surprising, for Recasens is the recognized leader of our specialty in Spain, and the numerous references in the text and the extensive bibliographies at the end of each chapter show that he has kept in closest touch with all developments both in his country and abroad.

It may interest American readers to learn that menarche occurs in Southern Spain at 13 years, and but one year later in the rest of the peninsula. Recasens prefers the dorsal posture for delivery, in contrast to English obstetricians who rather favor the lateral position. Chloroform, which he administers by a mask of his own construction, is the anæsthetic of choice in labor. Lateral episiotomy is preferable to median incision. Conservatism should prevail in the therapy of eclampsia; an abdominal cæsarean section adds another heavy burden to the exhaustion of the organism. Digital pelvimetry of the diagonal conjugate is depicted as being made with the index finger alone. I doubt whether it is possible to reach the promontory in a normally large pelvis with only one finger. Radiopelvimetry is resorted to rather frequently, and instructions are given as to how to obtain reliable results. A number of excellent X-ray plates both from his own material and from the well known work of Warnekros indicate that the author values X-ray photography. In marginal and lateral placenta prævia, rupture of the membranes, version, the Champetier bag, tamponade, etc., are indicated; the maternal mortality ranges between 6 and 10 per cent, that of the children between 40 and 60 per cent. Cæsarean section is permissible only in the case of central placenta prævia, if the child is alive.

If we cast a final glance upon the books reviewed in this issue and make note of their birthplaces—Austria, Germany, England, France, United States, Brazil, New Zealand, Spain—we must needs be impressed anew with the wide extent of our scientific fatherland *which is the world.*

[1] A Practice of Gynæcology. By Henry Jellett, M.D. (Dublin University), F.R.C.P.I. 5th ed. London: J. & A. Churchill, 1925.

[2] Surg., Gynec. & Obst., 1917, xxii, 713.

[3] Tratado de Obstetricia. By Dr. Sebastián Recasens, Prof. of Obstetrics and Gynecology, etc. 5th ed. Barcelona: Salvat, 1925.

AMERICAN COLLEGE OF SURGEONS

THE WIDENING RANGE OF MEDICINE[1]

By the Right Hon. LORD DAWSON of Penn, G.C.V.O., K.C.M.G., M.D., London, England

A DOUBLE honor is my portion tonight—your fellowship and the delivery of this address, and let me say how deeply I treasure it. If my expression of gratitude is brief, it is out of regard for the many other claims on your attention this evening, not forgetting the expectations for tomorrow which possess the minds of all citizens of Philadelphia. I will ask you, then, to liken my appreciation to the small hand of the clock which, though ranging one-twelfth of the distance of the long hand, signifies twelve times as much.

We have just witnessed a short but moving ceremony, the conferring of the Legion of Honour by Dr. de Martel upon Dr. Charles Mayo. The honor and the services of the recipient are alike unique in distinction. To all of our tongue in whatever land they be, this recognition not only of a great mind but of a genius for friendship will bring rejoicing.

In the choice of a subject suitable to this occasion, I was influenced by the knowledge that laymen, both interested and distinguished, would constitute a portion of the audience; so it occurred to me to present for your consideration how, on the one hand, medicine is increasing its contact with the sciences, and on the other hand, is extending the range of its influence to cognate activities in the body politic.

Medicine has, so to speak, an outer and an inner temple. In the inner temple searching and thought reign, and in the outer, action becomes the handmaid of thought.

During the twentieth century, progress in its sciences has been so notable that medicine has received fresh direction and inspiration. Thought is vivid, new pathways are opening out, and the time is instinct with new unfoldings.

And yet we should not forget the debt we owe to the times which have preceded us. It has often been that we have reaped because they have sown, and their achievements measure large when the slenderness of their resources is remembered.

And since the spirit of science awoke from its long sleep in the sixteenth century, it has been the proud part of medicine to foster and advance the sciences on which it now increasingly rests.

The dawn was first felt at Padua, where Vesalius, Fallopius, and others of world renown established human anatomy and where Harvey received a measure of that inspiration which gave life to physiology. Let me commend to those who have not yet undertaken it, a visit to this ancient seat of learning. Those of us, gathered as we were from all countries, who met there to celebrate the seven hundredth anniversary of its founding, have a treasured memory of an historic pilgrimage to do honor to greatness.

To the early knowledge of physics the medical profession made notable contribution. Gilbert, in the sixteenth century, Galvani and Young, in the seventeenth century, stand forth as great discoverers in magnetism, electricity, and light, respectively. They were all three physicians. The identity of the early progress of chemistry with the medical profession was even more close, and with biology are associated names such as John Hunter and Richard Owen. Of the total 115 original Fellows of the Royal Society, founded in the reign of Charles II, 25 were Doctors of Medicine.

It is curious to reflect that side by side with these rich contributions to knowledge by doctors, the general practice of medicine was, until the nineteenth century, befogged by fanciful reasoning and fantastic treatment. It could not shake itself free from habits of thought which had their origin far back in primitive beliefs in magic and hostile deities. And in present times, so persistent is tradition, the world is still imbued with belief if not in magic, yet in the magical, to the detriment of its true interests.

To quote Garrod in his eloquent Harveian oration: "The primitive medicine and the art of the medicine-man survive to this day among the savage races of the earth, and he would be a bold man who should deny their survival among those races which regard themselves as the highest products of civilization. Are any of us wholly free from such ideas?"

[1]Fellowship Address, delivered at the Thirteenth Convocation of the American College of Surgeons, Philadelphia, October 30, 1925.

It is difficult for us to convince the public that we have no wonders to offer except those to be found along the narrow and straight path of rational endeavor; and this is especially true in the realm of therapeutics.

We, in the profession, might set example by a more critical examination of our ways and means. We are apt to forget how many of our remedies and formulæ have descended by apostolic succession from previous generations. In order to illustrate, not what our formulæ are, but from what they have descended, let me quote you "An excellent Medicine for the Dropsie made for Queen Elizabeth by Doctor Adrian and Doctor Lacy:

"Take Polipodium, Spikanard, Squat, Ginger, Markoram, Galingal, Setwel, of each a penny weight, Setna leaves and cods, so much as all the rest grosly beaten, put them into a bag, and hang it in an earthen pot of two gallons of Ale, and every four daies cover the pot with new Barm, and drink no other drink for six daies, and this shall purge all ill humors out of the body, neither will it let the blood putrifie, nor flegme to have domination, nor Choller to burn, nor Melancholly to have exaltation, it doth encrease Blood, and helpeth all evill, it helpeth and purgeth Rheum, it defendeth the Stomack, it preserveth the body and engendereth good colour, comforts the sight and nourisheth the Mind."

There are features of this prescription which might make it popular today and even in this country.

And yet in that gray light there were glimmers in the sky. For instance, digitalis was in the pharmacopœia of 1665. Another example of cycles in knowledge is to be found in the fact that Gairdner recommended iodine for goiter 100 years ago. And that is dwarfed when we learn from Professor Schmidt that an herb, Ma Huang, containing an active principle similar to adrenalin, was sanctioned by the Emperor Shen Nung and used over 5,000 years ago.

Of the sciences on which medicine is now firmly founded, physiology, chemistry, and physics stand forth prominently, and their growing territories are widening the range of medicine. Chemistry in particular seems to be acquiring increasing contact with the science of the living body and mind, and one wonders, now that the mysteries of the atom have been penetrated, whether in the future, physics may not gather physiology and chemistry unto itself. And perhaps one of the reasons why the honor of your choice has this year fallen upon a physician is the recognition on your part that the progress of surgery will henceforth depend and in increasing measure on co-operation with medicine. Although technique will continue to improve, it will not command the position it has hitherto done. Speaking as a physician who has always been in close association with surgeons, I suggest that there is here and there a tendency to overemphasize mechanical aids, forgetting that greatness in art is to be found in simplicity. Your thoughts are turning to the study of the tissues and forces of the patient. With you, as with the physician, the cry is "Back to the soil."

The fear of sepsis no longer possesses the surgeon though it still influences his thought. You now rely on studies, it may be of liver, or pancreatic function, of sugar, chloride or non-proteid nitrogen content, of metabolic rates. These help you to understand the problem of each patient, the peculiarities, even the perversities of his symptoms and either to prepare him for operation or even excuse him operation, or guide him to convalescence. . Such co-operation with medicine will bring you results hitherto undreamed of. Is it not possible that biochemistry helps to measure the physical aspect of individuality? In the days when acute infections played so dramatic a part in life and death among peoples, when medical men were so largely occupied with their visitation and impressed with their own relative powerlessness to battle against them, it was only natural that thought should envisage disease more as an evil force from without, and set less value on the qualities belonging to the patient.

The banishment of typhoid and other fevers from our midst, the power over the protozoal diseases, the diminishing force of tuberculosis and syphilis; even acute rheumatism with the damage it inflicts on young life, is less powerful for evil—these and other achievements bear witness to a changing scene.

The sub-infections which play a relatively larger part in the health problems of today, bring home to us the importance of the individual or host, and the make-up of his body and mind. Their activities in each individual would seem to be determined by some internal factor—some nidus or influence which is probably specific for that person. Thus an attack of rheumatoid arthritis from infected teeth is determined as much by the internal factors individual to that patient as by the infective agent; and not the least suggestive feature of the recent advance in our knowledge of malignant disease from the brilliant researches of Gye and Barnard is the importance of this internal factor in the production of the disease. In short, specificity of the

soil looms as large as specificity of the infective agent.

From another point of view this concern of medicine for the individual man—his resistance—his qualities which make for good and for evil—pushes disease back to its beginnings. We thus become concerned with the fascinating though difficult study of trends and tendencies—with the border country between the physiological and the pathological, and this leads one to reflect that the limits of the physiological widen with the advance of civilization. And the body, like the mind, has its inborn traits. Physiological habit corresponds to character. Who is to say where peculiarity ends and fault begins? Advancing age tends to harden peculiarity into fault. Moreover, what we view as peculiarity in ourselves we are apt to term fault in other people. Thus determination becomes obstinacy, and strong will becomes self will, and conviction becomes obsession, and the latter suggests that the philosopher will make his convictions merry, so that his old age may possess content.

Take essential hypertension—no doubt this is sometimes an acquired condition but equally often it is an inborn, a physiological habit, an over-responsiveness of the vasoconstrictor mechanism which begins as a peculiarity and may end as a fault or disease—commences in the realm of the physiological and ends in that of the pathological. The irritable heart, the over-responsive abdomen are other examples. Our object should be to take cognizance of habits and trends, and so guide their human possessor that his potentialities operate for his good, not for his harm.

Here then there is contact between medicine and education—their spheres overlap—their needful aptitudes resemble. The qualities of mind needed in a diagnostician are as essential to the teacher as to the doctor.

And from this I am led to reflect that teaching will become a prescribed duty in the doctor's career.

How can it be otherwise?

If we are to get to the beginnings, if we are to guide people in the ways of health, if the community is to guard the health of its mothers, its babies, its school children, its industrial workers, the family doctor must become an educationalist and in part a health administrator. If he does not, his rôle will suffer progressive diminution, curtailed as it will be on the one hand by the whole time health official, and on the other hand by the invading specialist.

This will, in my judgment, be a disadvantage to the community. The family has need of its own doctor, known and trusted, and it is with his guidance its members should get all that is best from specialism, and this is the more necessary in a day when specialization begins early in the doctor's career and is apt to become restricted in vision.

The family doctor should remain the foundation of medical service, but his outlook, functions and training need modification to meet changing needs. First must come his care of the sick, but beyond that he will have communal and educational duties.

Take for example the value of medicine toward industry, the physical fitness of the worker, the survey of his environment, the gauging of the suitability of body and temperament to the work required, the strains connected with specialization, and that new large field of research into the problems of industrial fatigue.

In all these things, which concern not only the health and happiness, but the efficiency of the worker, medicine has responsibility.

Few doctors in a community could fulfill the whole range of such demands. I suggest that in the future the doctors of a district will form themselves into a faculty which would place the varieties of knowledge and experience of its members at the service of the community and in its collective capacity exercise a powerful and much needed influence on public life.

Withal let us do nothing which would impair the personal touch, the deep and abiding interest which mean so much in the hour of sickness, for our rosary needs to be strung with the beads of love as well as with those of thought.

How then are the members of this local faculty to hold high their standard of work? The answer is "by the hospital." Every district however rural should have a hospital adapted to its needs. For myself, I should like to see the conception of such a hospital widened to that of a health center where curative work, clinic, wards, communal services, educational facilities—could find a home—where doctors could improve their minds, give of their best, and find encouragement and restraint. And in this connection is to be found one of the most beneficent activities of this illustrious College.

This larger view of the district hospital carries with it a wider conception of the art of healing. Dietetics, physiotherapy belong as much to education as to healing. With greater knowledge we have come back to simplicity.

The surgeons first found salvation in fire by the discovery of asepsis, and the rest find in air and light a romance of healing. Who would have

thought a few years ago that the simplest of hospitals, built on the Cattle Byre type, with open air, sun, good food, aided by a knowledge of anatomy and physics, as their only armamentarium, would have produced the transformations to be found in modern orthopedic hospitals.

And the beneficial results extend far beyond the patients cured, for each one of the latter becomes a missionary of health, a nuisance to his family, in that he enforces upon its members light and air, to their surprise, discomfort, and salvation.

For one cured, many are saved; which dictum is further emphasized in the hygiene of the mouth, for the treatment of oral sepsis has done even more by its terrors than its cures.

Next, may I let chemistry lead me to another line of thought. In the discovery of hormones by Starling, chemical products were found to have a direct control of function. Consideration of the rôle of these chemical messengers, of which carbon dioxide may be said to be the exemplar, gives us a wider comprehension of the wisdom of the body; and the physical scope of, say, secretin and insulin is within our ken and gives clearness to our conceptions and range to our activities.

But that minute quantities of a chemical product, the output of a group of cells, should so far be the arbiter of the physical and mental states of the body that its presence will decide whether the body is to have or not have vigor and beauty, and the mind power to think and remember, leaves one almost dazed with wonderment. And yet so it is, as the isolation of the active principle from the thyroid gland exemplifies.

Again, it would seem that secondary, and to less extent, primary sex characteristics are the result of chemical substances originating in specialized groups of cells, and such bodies not only determine sex at the outset, but will change sex characteristics during life's progress; and with the bodily changes will be the corresponding modifications of mind and character, and if one goes one step farther and contemplates the beautiful attributes of the mother instinct which have inspired the art and religion of the world as resulting from stimulation by a chemical product, are not the limits of our comprehension passed, and our minds unsatisfied? Is the hormone the influence itself or the embodiment of the influence? Or is it the physical counterpart of the spiritual quality of influence?

There are, in both, the same qualities of subtle and reiterated effect; in both of them we get a detachment from the material conception of mere bulk and weight and our minds glide back to the "little leaven" and "the grain of mustard seed." The rôle of the infinitely small carries thought to the border country of the material.

From this it is but an easy step to my next theme, that is, the place of psychology in medicine, which term I take to signify the study of the mind in health and illness.

This must claim more of our attention, partly because the knowledge of mind has made striking advance, and partly because the need for its help increases. And psychology needs to be taken into the texture of medical practice and not regarded as an extraneous aid. Its delicate processes, requiring as they do insight and sympathy, find encouragement and balance, if they are as the warp to the woof of physical symptoms.

Standing apart, psychological practice may easily fail in acceptance and purpose, and even produce antagonism. This is due in part to the outlook of patients, and in part to the crudity of many of its exponents.

Broadly speaking, patients regard disturbances of mind as things they can avoid, and disturbances of body as things they cannot avoid.

Although neurosis is equally, if not more, prone to attack the higher type of mind, its diagnosis is apt, in spite of every explanation, to debase the patient and prejudice cure. So it happens that the physical and psychical should, wherever possible, be handled together. Priority of presentation should be given the physical, and it should be remembered that the disturbed mind is often helped best by treatment which is incidental and even unwitting. This is only another way of saying that the finer thoughts and feelings may be killed by attempts to give them a too concrete form. And yet, by a strange irony, there is a school of psychological medicine, earnest in advocacy, which has presented us a picture of the human mind and its processes, so crude and unattractive as to prejudice the acceptance of the great and valuable learning on which it is based.

For in truth medicine owes a great debt to those teachers, Freud, and others, whose inspiration has disclosed to us the workings of the unconscious mind and their relations to those of the conscious. The principles of these teachers are not less true because the latter overstressed the rôle of the sexual instinct and their disciples have mistaken the wood for the trees.

And the conditions of modern life, its speed, its complexities, the fact that mechanical invention has outstripped man's power of adaptation, must not only produce exhaustions, but set up strains, conflicts, and make the mind enter more into the make-up of illness than in the placid

days of yore. And so it happens that not only do neuroses become more common, but physical illness is apt to be overlaid and interthreaded with troubled states of mind. Clinical values have changed. And the vagaries in the manifestation of disease which so often vex its unraveling are sometimes the result of mind reactions—of personality.

How often do we not find that an illness with a physical basis, which is perhaps amenable best to surgical interference, may have a superstructure of functional disturbances due to present or buried mental experiences, not only perplexing the patient and doctor, but prejudicing recovery. Thus is explained why some operations cure the condition, but not the patient.

It is an interesting reflection that while on the one hand the technique of diagnosis is growing in range and reliability, on the other hand the problem before it grows in complexity.

This tells us that laboratory technique, though essential, is not all-sufficing; it throws light on the morbid process but not on the reaction of the latter. It leaves individuality untouched, unless, as is possible, variations in biochemical reactions may in the future disclose a correspondence with variations in bodily and mental functions.

I will next refer to the handling of the mind factor in disease. For reasons given, the technique of psychoanalysis, suggestion, and hypnotism, though in specially skilled hands, and in exceptional cases useful, are in general medicine seldom necessary or desirable. The mind cannot, like the body, always stand set and formal treatment, for the texture and interlacing of the threads of its web are too delicate. Exploratory operations on the mind do not always heal by first intention.

The best treatment often lies in comprehensive diagnosis, and by that I mean the unraveling and exposition, not only of the nature of the morbid process, but the physical and mental states associated with it.

Sort out a patient's symptoms for him. It is not things, but the significance of things which matters. Discomforts ignored in health are liable in neurosis to become obtrusive and produce fears. Such may impede the cure of bodily illness; or a function may be raised in consciousness; or again, a conscious experience may be misinterpreted, and assume a sinister significance; or again, exhaustion may lessen control, so that an instinctive tendency naturally suppressed rises up and produces conflict.

Such factors must, in my judgment, contribute increasingly to the make-up of illness and demand our recognition. Explain causes, dissolve doubt, and, side by side with the best physical treatment, restore perspective, and the path to recovery and contentment opens out.

An important part of therapeutics is a willingness to listen, a perceptive, understanding mind and lucid, persuasive exposition.

To those who have tonight been received into your Fellowship, may I offer my felicitations and good will. A great heritage and an inspiring outlook are theirs—quest of knowledge, the beauty of craft, the privilege of help and healing, the leadership of their communities toward increasing health and contentment. Between nations medicine stands for reason, forbearance, and mercy, and with the English speaking peoples, it is a beacon light showing the way to closer understanding and the unity of an ever-deepening friendship.

AMERICAN BOARD OF OTOLARYNGOLOGY

An examination will be held by the American Board of Otolaryngology in Dallas, Texas, on Monday, April 19, 1926, and in San Francisco, California, on Tuesday, April 27, 1926. Application should be made to the Secretary, Dr. H. W. Loeb, 1402 South Grand Boulevard, St. Louis, Missouri.